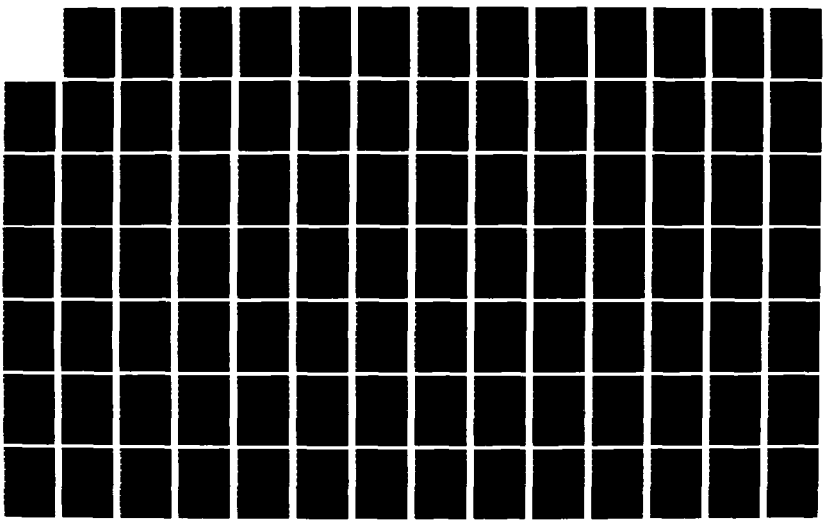
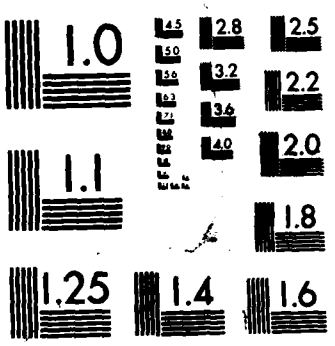
AD-A172 158 THE CLINICAL EFFECTIVENESS OF SUBGINGIVAL SCALING AND ROOT PLANNING IN VI (U) AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OH L A HUMBERT 03 OCT 85 1/2

UNCLASSIFIED AFIT/CI/NR-86-168T F/G 6/5 NL





SECURITY CLASSIFICATION OF THIS PAGE (W

REPORT DOCUMENT

AD-A172 158

INSTRUCTIONS
OMPLETING FORM
ATALOG NUMBER

1. REPORT NUMBER
AFIT/CI/NR 86- 168T

4. TITLE (and Subtitle)
The Clinical Effectiveness of Subgingival Scaling and Root Planning: In Vivo, Direct versus Indirect Root Surface Debridement

5. TYPE OF REPORT & PERIOD COVERED
THESIS/DISSERTATION

6. PERFORMING ORG. REPORT NUMBER

7. AUTHOR(s)
Lewis Arthur Humbert

8. CONTRACT OR GRANT NUMBER(s)

9. PERFORMING ORGANIZATION NAME AND ADDRESS
AFIT STUDENT AT: The University of Texas

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS

11. CONTROLLING OFFICE NAME AND ADDRESS

12. REPORT DATE
1985103

13. NUMBER OF PAGES

14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)

15. SECURITY CLASS. (of this report)
UNCLASS

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)
APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES
APPROVED FOR PUBLIC RELEASE: IAW AFR 190-1

LYNN E. WOLAVER 9 Sept 86
Dean for Research and
Professional Development
AFIT/NR

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)
ATTACHED ...

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

THE CLINICAL EFFECTIVENESS OF SUBGINGIVAL SCALING AND ROOT PLANING: IN VIVO, DIRECT VERSUS INDIRECT ROOT SURFACE DEBRIDEMENT

A

THESIS

Presented to the Faculty of

The University of Texas Graduate School of Biomedical Sciences

at San Antonio

in Partial Fulfillment

of the Requirements

for the Degree of

MASTER OF SCIENCE

By

Lewis Arthur Humbert, B.A., D.D.S.

San Antonio, Texas

June, 1985

The Clinical Effectiveness of Subgingival Scaling and Root Planing: In Vivo, Direct Versus Indirect Root Surface Treatment

Lewis Arthur Humbert

APPROVED:

Thomas C. Waldrop
Supervising Professor

Harold D. Wachtel

Jan Cobb

Carol V. Brownstein

James J. Leone

November 13, 1985
Date

APPROVED:

A. J. Guarino
A. J. Guarino, Ph.D
Dean

DEDICATION

I dedicate this Thesis to my wife whose patience, understanding and love has sustained and uplifted me throughout the last three years.

She is the motivation and purpose for all that I do.

The works of God continue
And worlds and lives abound;
Improvement and progression
Have one eternal round.
There is no end to matter,
There is no end to space;
There is no end to spirit;
There is no end to race.

William W. Phelps

ACKNOWLEDGEMENTS

I am grateful to my mentor, Dr. Thomas C. Waldrop, for his encouragement and guidance in executing this study. Dr. Donald G. Moskowicz provided considerable assistance reviewing the manuscript and along with Dr. Waldrop provided help with the clinical aspects of the Thesis. Drs. James J. Lane, Carol N. Brownstein and Thomas B. Aufdemorte all worked diligently in reviewing the manuscript for this Thesis. I would like to thank Martha Westbury from Zeiss Optical for providing the necessary instruments to complete my Research. I would also like to thank Major Wayne Pierson for providing his expertise to the statistics in the Thesis.

I want to acknowledge the United States Air Force Dental Corps which provided support for my graduate education in periodontics. The opportunity to progress and learn is greatly appreciated.

Finally, I would like to thank my two young daughters, who although not understanding what they have done, have given my life and pursuit of knowledge a new determination and meaning.

The Clinical Effectiveness of Subgingival Scaling and Root Planing: In Vivo, Direct Versus Indirect Root Surface Debridement

Lewis A. Humbert, M.S.

The University of Texas Graduate School of Biomedical Sciences at San Antonio

Supervising Professor:
Thomas C. Waldrop, D.D.S., M.S.
Lieutenant Colonel, USAF, DC
Assistant Chairman for
Clinical Investigation
Department of Periodontics
Wilford Hall USAF Medical Center

This study compared the effectiveness of subgingival bacterial plaque and calculus removal following periodontal scaling and root planing using an indirect (closed) versus direct (open) periodontal flap approach. Patients requiring extractions due to advanced periodontal disease were the source of the 60 single rooted teeth comprising the study group.

The periodontal status of test and control teeth was

evaluated initially by the Gingival Index (G.I.) of Loe and Silness, the Plaque Index (PlI) of Silness and Loe and the Periodontal Index (PDI) of Ramfjord. In both experimental groups, the time and number of curette strokes needed to achieve a smooth, hard root surface was compared. Teeth were divided into three groups of 20 each: a closed, an open and a control group. For reference, the level of the gingival margin was marked on teeth in order to delineate subgingival from supragingival plaque and calculus after tooth extraction. Following local anesthesia teeth in the closed group were scaled and root planed to clinical smoothness. In the open group a mucoperiosteal flap was reflected buccally and lingually to provide visual access and the teeth were scaled and root planed to visual and clinical smoothness. All teeth were extracted immediately following scaling and root planing. Control teeth were extracted at the same treatment appointment taking care in all groups not to disrupt the root surface with the forceps. Teeth were rinsed in running water and stained with methylene blue for two minutes. They were then stored in 10% formalin and all teeth were examined concurrently. Stained teeth were viewed under a stereomicroscope using a magnification of 10X. Measurements were taken using a calibrated grid system to assess residual plaque and calculus on treated and control subgingival root surfaces.

The results favor the open flap procedure by a mean of 20.51% greater effectiveness. However, if one considers the root

surfaces by various depths and surface areas, there is no statistically significant difference between the open and closed treatment when the periodontal pocket is greater than 3.0 mm deep. Although there was an 18% mean increase in effectiveness of plaque and calculus removal at depths greater than 3.0 mm by the open approach it did not prove to be statistically significant. This was due to the large variance within group values.

The amount of residual plaque and calculus deposits that can remain on a root surface without contributing to further periodontal breakdown is unknown. While an 18% increased debridement effectiveness is not statistically significant, it may nevertheless be clinically significant. Until more information becomes available, it would appear that the open flap approach is preferred in pockets greater than 3.0 mm in depth.

TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

LIST OF TABLES

LIST OF FIGURES

I. INTRODUCTION

Chronic periodontitis is one of the most common forms of periodontal disease. Initial treatment should involve the elimination of supra and subgingival plaque and calculus, known periodontopathic agents.[1,2,3]

Scaling and root planing are the two most common techniques used to remove bacterial plaque and calculus from the root surface. Hellden, Listgarten and Lindhe have shown that G.I. scores are significantly lower in patients that have been scaled and root planed.[11] In a group of patients having periodontal disease, Tagge, O'Leary, and El-Kafrawy have demonstrated a significant reduction of mean pocket depth by the addition of root planing to a regimen of oral hygiene.[12]

Ramfjord and Knowles have suggested that it appears necessary to remove all retained plaque and calculus from diseased root surfaces in order to achieve a healthy dentogingival unit.[3] Waerhaug's studies have shown that a normal dentoepithelial junction can routinely be reformed in areas where subgingival plaque and calculus have been removed.[13,14] However, residual subgingival plaque left on root surfaces following scaling and root planing can give rise to rapid reformation of subgingival plaque and compromise periodontal health.

It has been shown that burnished calculus is often left on roots judged to be clinically smooth.[2,16] Microscopic and

scanning electron microscopic (S.E.M.) studies have shown significant residual calculus to be present on root surfaces that clinically felt smooth. Although calculus may not be the primary etiologic agent in periodontal disease, the surface of calculus is capable of harboring bacterial plaque which may inhibit formation of a new junctional epithelium. The potential pathologic of both plaque and calculus necessitates their complete removal from root surfaces.

The difficulty in complete removal of all plaque and calculus by hand and ultrasonic devices has been well documented. Both Jones et al. and Thornton et al. studies revealed subgingival plaque and calculus present after thorough scaling.[16,21] Thornton et al. showed that 33% of root surfaces, post-scaling, remained covered with plaque.[21] Jones and O'Leary state that vigorous root planing is needed in order to remove calculus and diseased cementum.[22] Despite thorough subgingival root planing, they still noted 18.75% residual calculus.

Waerhaug stated that a pathologic pocket is one containing subgingival plaque. It has been shown that if bacterial plaque or calculus is left on the root surfaces, gingival inflammation will persist. The inflammatory gingival reaction may not be detectable clinically if adequate supragingival plaque control is maintained.[13,14,25] Therefore, the clinician may be led to believe that treatment has been successful. The aim of

periodontal therapy is to produce a tooth and root surface that is free of biologically incompatible plaque and calculus deposits which will result in a healthy junctional epithelium and inflammation free gingival stroma.

The cause of inadequate subgingival scaling and root planing may be due to insufficient access, specifically the inability to directly view the root surfaces to be debrided.[43] Studies by Waerhaug and by Rabbani et al. suggest that until a better method can be found for detection and removal of subgingival plaque and calculus, direct vision of root surfaces may be the only reliable alternative for treating root surfaces associated with pockets in excess of 3 mm. It has been hypothesized that the degree of root access is directly related to the thoroughness of plaque and calculus removal in greater than 3.0 mm pockets. Increased access to diseased root surfaces in deeper pockets via an open flap technique should increase thoroughness of plaque and calculus removal.

The purpose of this study is to compare the relative effectiveness of bacterial plaque and calculus removal following subgingival root planing and scaling utilizing both an indirect (closed) versus direct (open) flap approach. Numerical quantification of data will be subjected to statistical analysis to test for a difference between the two treatment methods.

The present study examines the relative effectiveness of

plaque and calculus removal following a surgical open flap procedure versus a nonsurgical closed approach. Percentages of residual plaque and calculus on diseased root surfaces are presented for various pocket depths as proposed by Waerhaug and Rabbani et al.[14,43] The significance of the data may be useful in deciding whether to use a surgical or nonsurgical approach in performing definitive subgingival scaling and root planing.

II. LITERATURE REVIEW

A. Overview of Effectiveness of Scaling and Root Planing:

Chronic periodontitis is one of the most common forms of periodontal disease. The classic treatment is the complete removal of supra and subgingival plaque and calculus.[1,2,3] It has been well established that bacterial plaque is the primary etiologic factor related to the initiation and progression of periodontal disease.[4] Although it is generally acknowledged that the plaque overlying calculus deposits is the primary etiologic agent in periodontitis, Allen and Kerr [5] have shown that even after autoclaving to remove surface plaque, calculus can still exert a toxic effect on tissue cells. Therefore, if calculus is detrimental to the integrity of the periodontium, its thorough removal would be mandatory for the treatment and prevention of periodontal disease. An understanding of calculus attachment to the tooth should be examined if the clinician is to attempt its complete removal.[6]

Total calculus removal has been advocated to facilitate healing and reattachment.[7-9] King[10] has shown that retained calculus forms a nidus for new calculus reformation which proceeds more rapidly than calculus formation on a smooth calculus free root surface.

Zander (1953) described four types of calculus attachment: (1) via secondary cuticle interface between calculus and tooth

structure; (2) direct attachment, attachment of calculus matrix to irregularities of the cementum surface corresponding to prior insertion locations of Sharpey's fibers; (3) microbial penetration into cementum by calculus forming organisms; and (4) mechanical retention of calculus into undercuts in areas of cementum resorption. Moskow[8] reported on calculus attachment to partial cemental tears, a fifth method of calculus attachment. Cemental separations are a frequent observation in human periodontal tissues. These cemental separations are often the site of plaque and calculus accumulation.

Recently, studies using the electron microscope have more definitively shown the nature of calculus attachment to the tooth. Selvig[9] stated that the predominant mode of calculus attachment was through direct contact of calculus to the cemental intercellular matrix. Selvig questioned the direct attachment of bacteria to root surfaces. Seldom observing a cuticular attachment, he theorized that inorganic intercrystalline forces might be a significant factor contributing toward attachment.

More recently, Canis[6] confirmed previous histologic findings of (1) cuticular attachment, (2) mechanical locking into undercuts, and (3) direct attachment of calculus matrix to the tooth surface. Bacterial penetration as a mode of attachment was rejected. Canis demonstrated via ultrastructural SEM that the most frequently encountered method of calculus attachment was the

melding of calculus matrix to the surface of cementum.

Ramfjord (1973) suggested that it is necessary to remove all retained plaque and calculus from diseased root surfaces in order to achieve a healthy periodontium.[3] Waerhaug's studies in 1978 showed that a normal dentoepithelial junction can routinely be reformed in areas where subgingival plaque and calculus have been removed.[13,14] However, following scaling and root planing, residual subgingival radicular plaque can give rise to rapid spread of subgingival plaque and impede formation of a normal dentoepithelial junction.[13,14] Bodecker (1943) noted on photomicrographs of sections of diseased teeth that supragingival calculus and most, but probably not all, subgingival calculus can be eliminated. He stated that clinically, "the gingivae returns to a normal condition after careful scaling, medication and massage by the patient, but it is a common clinical observation that the inflammation recurs after a comparatively short time."[15] The question then arises, "Is it not probable that this relapse is due to the presence of remnants of subgingival calculus in the base of the gingival pocket?" Bodecker demonstrated microscopically that minute particles of subgingival calculus do in fact cause an inflammatory response within the periodontal membrane.

Following conventional scaling and root planing, burnished calculus can be observed on roots judged to be clinically smooth.[2,16] Microscopic and scanning electron microscope

(S.E.M.) studies have shown significant residual calculus on root surfaces that clinically felt smooth. Data suggest that effects of both plaque and calculus retention on diseased root surfaces necessitates their complete removal.

Jones et al.[16] have shown that hand and ultrasonic instruments are equally effective in the removal of bacterial plaque and calculus.[16] In contrast, Nishimine and O'Leary reported that root planing as performed in their study was more effective than ultrasonic scaling in the removal of calculus and endotoxins from periodontally involved root surfaces.[17] Both Waerhaug in 1978 and Nishimine and O'Leary in 1979 noted that plaque and calculus can inadvertently be left behind after conventional scaling and root planing.[13,14,17] Schaffer has also shown that routine scaling does not adequately render all root surface calculus free.[18] Barnes and Schaffer[19] found when calculus remained after subgingival root planing, that it was found most frequently on either mesial or distal surfaces. The root surfaces most frequently devoid of calculus were the line angles mesial and distal to the buccal or labial surfaces. Waerhaug, in subgingival scalings of pockets 3mm or less, found that the effectiveness of removing all subgingival plaque was good, in 3-5mm pockets, the chance for failure was greater, and in pockets more than 5mm, the chance for failure predominated.[14] In all of the aforementioned studies, scaling and root planing was

accomplished using a conventional indirect (i.e., closed subgingival) approach to root debridement.

Adding to the difficulty of closed subgingival root debridement is the topography of the root surface. Root surface topography can play an important role in preventing complete subgingival plaque and calculus removal. Frumker (1956) stated that due to root topography, complete removal of all plaque and calculus can be very difficult.[20]

Stambaugh et al.[23] studied the effectiveness of conventional scaling in 42 periodontal pockets ranging in depth from 1-10mm. Stambaugh stated that, "it therefore may not be practical, or even possible, to achieve, in one instrumentation session, a root surface free of those agents responsible for most periodontal disease when pocket depth is greater than about 4mm." Recently, Eaton et al.[24] analyzed photographic slides of scaled and root planed teeth either before or after the reflection of surgical flaps. Using an image analysis system to measure the areas of stainable root surface deposits, their findings revealed that in no instance was any root surface found to be completely free of stainable deposits.

Clinicians have debated the effectiveness of surgical versus nonsurgical debridement of the root surface in deep periodontal pockets. Stambaugh[23] has stated that tight gingival tissue, tooth position and tooth morphology can complicate the

effectiveness of nonsurgical therapy.

Garrett[26] in a recent review on the effects of nonsurgical periodontal therapy in humans concluded that root planing was an effective method for the treatment of both moderate and severe periodontitis. Cercek et al.[27] studied the effects of a single episode of root planing on single rooted teeth and observed a significant improvement in clinical parameters measured including: bleeding scores, plaque scores, probing depths, and attachment levels. Caton,[28] in an earlier paper, observed greater improvement in clinical parameters to include probing depths in areas with deeper initial probing depths. Badersten et al.[29-31] in studies from 13 months to 2 years, found no significant difference in clinical results when comparing the effectiveness of single versus repeated root instrumentation. Badersten suggested that deep periodontal pockets in areas of incisors, cuspids, and premolars may be successfully treated by plaque control and a single episode of root instrumentation. Implications that nonsurgical therapy may be successful in controlling periodontitis can be found in a number of studies comparing root planing with various surgical modalities. Hill,[32] Pihlstrom,[33,34] and Lindhe[35] have all reported similar results supporting this hypothesis. In general, these authors noted a loss of attachment following Modified Widman flap procedures as compared to scaling and root planing alone in sites that were

initially shallow (1.0 - 3.0 mm). For pockets initially 4.0 - 6.0 mm in depth, attachment levels were maintained by both procedures but scaling and root planing resulted in greater gain in attachment in comparison to the flap at all time intervals recorded. Treatment by either procedure of pockets greater than or equal to 7.0 mm in depth resulted in a sustained gain in attachment with no difference between procedures.[44] However, Garrett has noted that the clinical improvement in probing attachment levels observed as a result of nonsurgical therapy seems to be due to an improvement in both gingival health and gingival adaption to the tooth surface. Improved tissue health may itself increase the resistance to probe penetration. Therefore, improvement in probing measurement does not necessarily occur as a result of new connective tissue attachment. According to Badersten,[30] in spite of apparent overall successful results, some sites show progression of the disease process following conventional root treatment.

Improvement of clinical parameters following supra and subgingival scaling and root planing have also been associated with changes in the microflora.[36-39] However, the microbial changes observed after nonsurgical periodontal therapy may be more transient than the clinical changes.[26] Slots et al.[39] observed microbial repopulation of root planed pockets within a period of 2-6 months following a single course of scaling and root planing. Mousques et al.[40] found a general trend toward return of

pathologically associated micro-organisms to baseline levels two months following a single episode of instrumentation. Garrett[26] states that , "it is possible that the microbial repopulation of pockets may reverse the clinical improvement seen following nonsurgical therapy before the full potential benefits have been achieved." Mousques et al.[40] noted, following instrumentation without improved plaque control, that recolonization of subgingival micro-organisms seems to occur within a few months. In addition, Magnusson et al.[41] have shown that in the presence of supragingival plaque, a subgingival microbiota containing large numbers of pathologically associated organisms can reestablish within 4 to 8 weeks. In addition, a small number of sites with deep pockets (>8mm) were not substantially reduced in depth following conventional subgingival instrumentation. In these sites, which were kept free from supragingival deposits, a subgingival microbiota with a large proportion of pathologic-related bacteria returned within 42 days. Magnusson[41] has postulated that bacteria found in these deep sites orginated from a microbiota which was not removed during conventional sessions of subgingival instrumentation.

The cause for incomplete subgingival scaling and root planing may be due to insufficient access, either for instrument positioning for a favorable rake angle or the inability to directly view the root surfaces. [24,42,43] Pihlstrom et al.[44] noted that

decisions for or against soft tissue surgery should be made on the basis of individual patient considerations. Recently Lindhe et al.[45] in a paper on long-term effects of surgical versus non-surgical treatment of periodontal disease, stated that present findings suggest that sites with pocket depths exceeding 3mm respond equally well to nonsurgical and surgical treatment. This statement was based upon probing depth and attachment level data from sites which were free of supragingival plaque at the 6, 12, 24, 36, 48 and 60 month reexaminations. The author suggested that the critical determinant in periodontal therapy is not the technique (surgical or nonsurgical) that is used for the elimination of the subgingival infection, but the quality of root surface debridement.[45] However, much controversy exists relative to the validity of clinical criteria for determining the end point for successful treatment.

B. Summary:

Scaling and root planing are techniques for root surface cleansing. Their aim is to remove bacterial plaque, calculus, and other pathologic products from diseased root surfaces. Although the objective may be simply stated, it is not easily achieved. The difficulty lies in the development of tactile acuity in seeking out and removing deposits. The aforementioned studies tend to demonstrate that with a surgical or nonsurgical modality there is

apparently equal effectiveness in establishing clinical gingival health and in preventing further loss of attachment. Our goal for success, however, is the complete removal of root surface plaque and calculus. The thoroughness with which this is done forms the basis for deciding which treatment approach to follow. It should be realized that subgingival scaling and root planing is a difficult procedure which requires not only a skillful operator but also a knowledge of the patient's desires and the expediency with which the procedures are to be accomplished. Decisions for or against soft tissue surgery must be made on the basis of each individual's needs and requirements. Ultimately, any advantage of one technique over the other in terms of access required for thorough treatment should be a significant factor in the selection of therapeutic modalities.

C. Statement of Problem:

Studies by both Waerhaug[14] and Rabbani et al.[43] have suggested that direct vision of root surfaces may be the only reliable alternative for treating root surfaces associated with pockets in excess of 3.0 mm. It has been hypothesized that the thoroughness of plaque and calculus removal in 3.0 mm versus deeper pockets is related to the degree of access. Therefore, if this assertion is true, increased access to diseased root surfaces in deeper pockets via an open periodontal flap approach should

increase the thoroughness of plaque and calculus removal. This study compared the effectiveness of bacterial plaque and calculus removal following periodontal root scaling and planing using an indirect (closed) versus direct (open) periodontal flap approach.

D. Null Hypothesis:

This study tested the hypothesis that there is no statistically significant difference between the effectiveness of bacterial plaque and calculus removal following periodontal root scaling and planing using an indirect (closed) versus direct (open) flap approach.

III. METHODS AND MATERIALS

A. Study Population:

Patients presenting to MacKown Dental Clinic for extraction due to advanced periodontal disease provided the patient pool. Sixty (60) single rooted teeth with severe periodontitis (prognosis hopeless) comprised the study group. Experimental and control teeth were taken from the same subject when possible. All patients participating in this study were required to sign a consent form (Appendix E-1). The treatment and care of all patients complied with AFR 169-6 and the human use committees (UTHSC-SA).

B. Collection of Data:

1. Test and control teeth were evaluated by the following parameters:

a. Gingival Inflammation: Gingival inflammation was assessed using the Gingival Index (G. I.) of Loe and Silness[48] (Appendix B-1).

b. Plaque: The amount of supragingival plaque accumulation associated with both test and control teeth was assessed according to the Plaque Index (PlI) described by Silness and Loe[49] utilizing a disclosing agent (Appendix B-2).

c. Periodontal Health: A composite score for the periodontium was assessed according to the criteria of the

Periodontal Disease Index (PDI) of Ramfjord[46] (Appendix B-3).

d. Levels of the Free Gingival Margin: A fixed reference indention point mid-buccally and mid-lingually was made in the teeth at the level of the free gingival margin using an inverted cone bur.

e. Probing Depth: Probing depths were taken with a University of Michigan O type probe head graduated at 1, 2, 3, 5, 7, 8, 9 and 10 mm. The probe was spring loaded to a maximum of 25 pounds of force. All measurements were taken from the free gingival margin with the same probe and by the same examiner. The probe was aligned parallel to the long axis of the tooth. Interproximally, the probe was angled no more than 5^{o} from the vertical axis of the tooth so as to end below the contact point. Six measurements were taken on control and test teeth and included: mesiobuccal, buccal, distobuccal, lingual, distolingual, and mesiolingual tooth surfaces. All measurements were rounded to the nearest millimeter.

2. Additional documentation included:

a. Radiographs: Routine radiographs were taken pre-operatively using a long cone paralleling technique and a Rinn XCP film holder. A Fixott-Everett grid was used with each radiograph. Kilovoltage (kvp), milliamperes (ma), and time exposure per tooth were kept constant.

b. Photographs: Routine clinical photographs of

the experimental teeth were taken at the procedure. In addition, photographs of stained root surfaces were also taken.

c. Grouping: Experimental teeth were divided into three (3) groups:

(1) Group 1 (n = 20): Indirect (closed) root surface treatment.

(2) Group 2 (n = 20): Direct (open) root surface treatment.

(3) Group 3 (n = 20): Control; no scaling and root planing.

d. Laboratory Determination of Root Surface Plaque and Calculus: In order to assess effectiveness of plaque and calculus removal, the roots were subdivided longitudinally and cross sectionally. Longitudinal divisions (mesial, distal, buccal, and lingual) were measured from the line angles of each tooth and marked by a small curette scratch and/or an ultra fine black felt tipped marker (Figure 1). Cross sectionally, the root was divided into areas from 0 - 3.0 mm, 3.0 - 5.0 mm and greater than 5.0 mm (Figure 2).

e. Time: Teeth were scaled until they felt clinically hard and smooth (standard clinical criteria for adequacy of scaling and root planing). Overlapping strokes and a newly sharpened curette were used with each tooth. The time spent instrumenting each root surface and the number of instrument

Figure 1. Illustration of longitudinal divisions of the four measured tooth surfaces. Mesial, distal, facial and lingual surfaces were divided at the line angles.

FIGURE 1

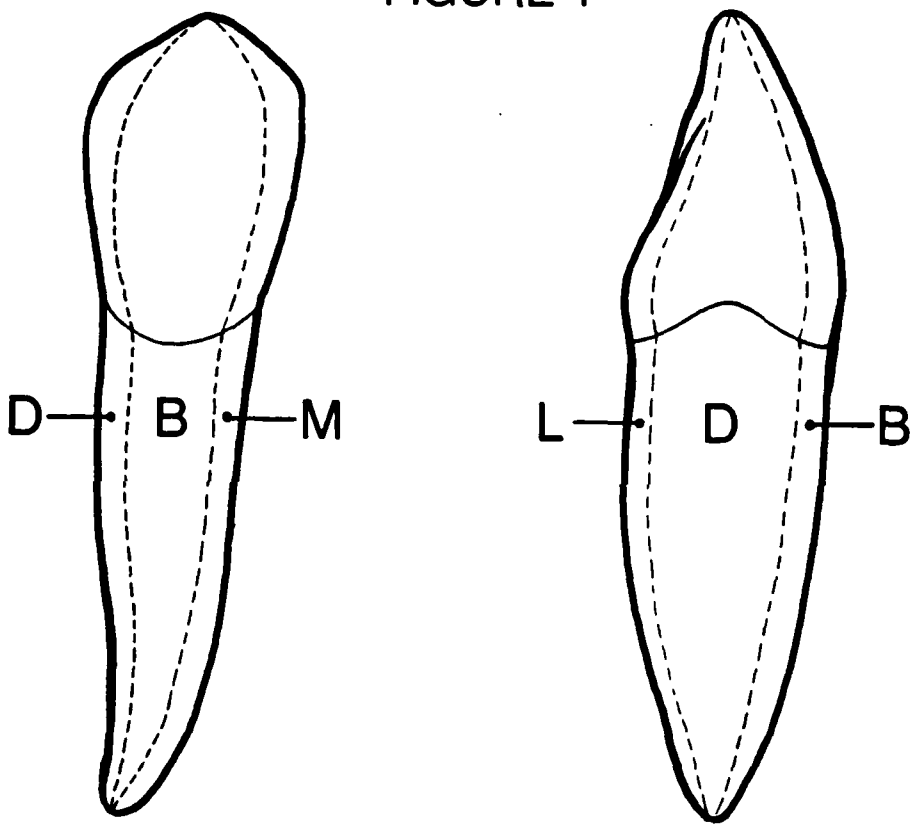
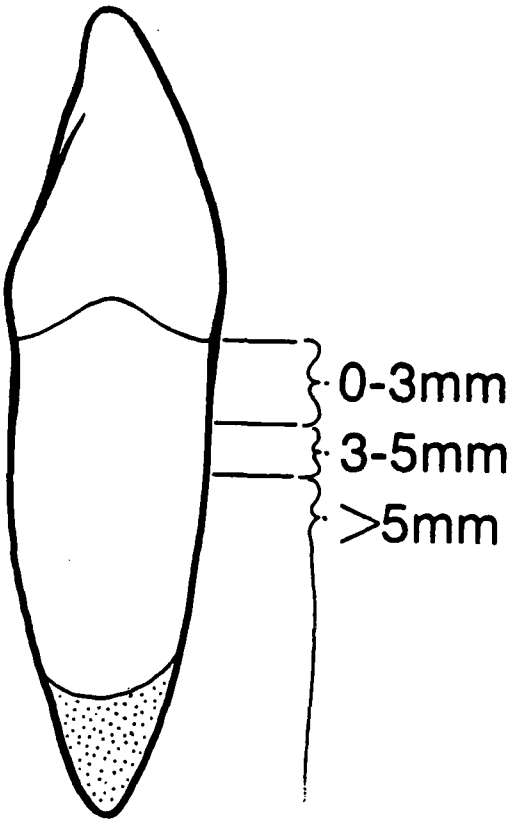


Figure 2. Illustration of cross-sectional divisions of measured tooth surfaces. Pocket depths were divided as shown based upon data from previous studies.

FIGURE 2



strokes used for each tooth were quantified.

C. Experimental Design and Technique:

Scaling and root planing utilizing both direct and indirect techniques were performed by the same operator on all experimental teeth except for four experimental teeth instrumented by the supervising professor. Following local anesthesia, Group I teeth were scaled and root planed thoroughly with hand instruments. A No. 3 explorer was used to check for smoothness of scaled and planed root surfaces. Following local anesthesia in Group II, mucoperiosteal flaps were reflected on both the buccal and lingual aspects of the experimental teeth. Granulation tissue was removed circumferentially and the root surfaces were scaled and root planed thoroughly with hand instruments. A No. 3 explorer was used to check for smoothness of scaled and root planed surfaces.

Using the methodology of Rabbini and Caffesse, the level of the free gingival margin was marked with an inverted cone bur mid-buccally and mid-lingually on scaled and control teeth.[43] This marker later oriented the locations of residual plaque and calculus on treated root surfaces relative to probing depths.

Experimental teeth were extracted immediately following scaling and root planing. Care was taken not to disrupt the root surfaces with forceps. The teeth were rinsed in running water to

remove blood and adherent debris and were placed in a one per cent methylene blue dye solution for two minutes.[43,47] They were then rinsed with running water again for 2-3 minutes and were placed in 10% buffered formalin and stored until examination. All teeth were examined concurrently.

Post extraction, all periodontal flaps were sutured with 3-0 silk sutures. Verbal and written postoperative instructions and an analgesic were given to each patient.

The one week postoperative follow-up included suture removal and healing assessment. All patients were followed postoperatively in order to evaluate healing.

D. Analysis of Data

Stained teeth were viewed under a Zeiss stereomicroscope using a magnification of 10x. Measurements were taken using a calibrated grid system as described by Rabbani and Caffesse.[43] Residual root surface calculus and bacterial plaque were assessed using an eyepiece mounted Net Micrometer Disc, 10 mm x 10 mm square and subdivided into 100 squares. The total number of squares representing the surface area of diseased roots were counted. Only surface areas covering more than one-half of a square were counted as a square unit (Figure 3). The total number of squares with plaque and calculus representing all root surfaces was counted. The percentage of squares with plaque and calculus

present was then obtained. In assessing plaque and calculus, all squares containing even small amounts of residual deposits were counted as one (Figure 3).[43] Measurements were done three times on each surface by the same examiner to ensure reproducibility. The average score was reported.

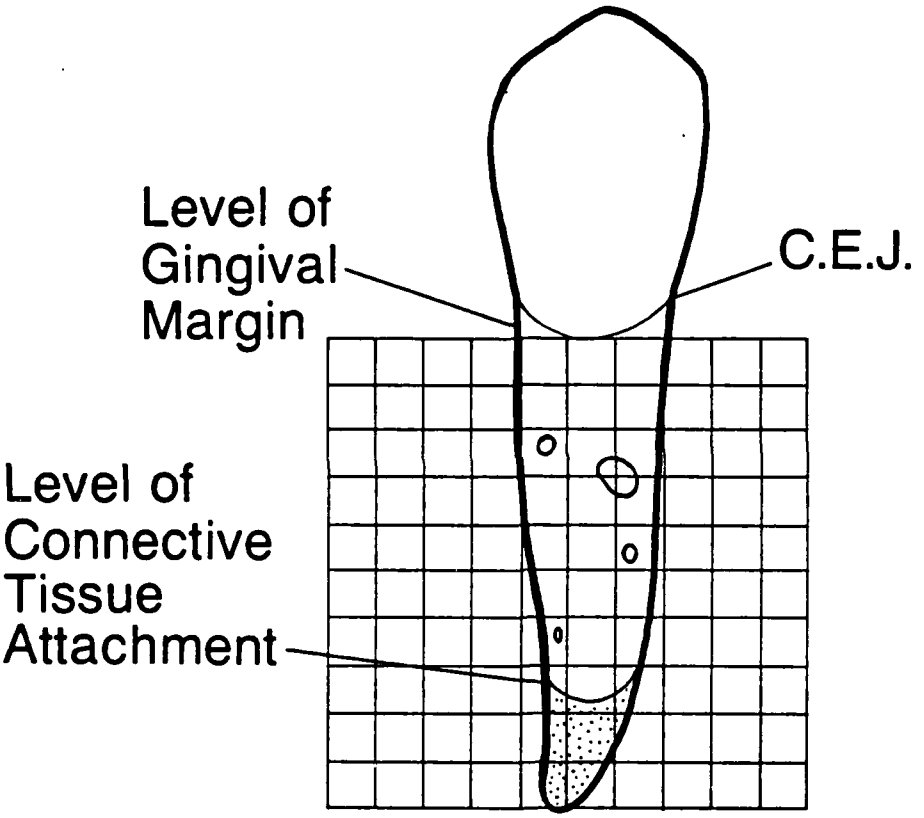
Experimental parameters used to compare the difference between groups were the GI, PlI, PDI, scaling time and number of curette strokes used to scale and root plane the teeth. These were assessed by examining mean data and maximum/minimum ranges. GI, PlI and PDI were included to indicate the periodontally compromised status of the research teeth.

The percentage of plaque and calculus present on the teeth in each of the three groups was assessed for group means, standard deviation, ranges, one-way analysis of variance and Student T-test for between group differences. Using these mean integrated data inter and intra group parameters and percentages were calculated for the two scaling and root planing methods. In both cases, if the effects of open and closed scaling and root planing are similar between techniques, there will be no statistically significant difference between the groups.

The analyses were done using the BMDT Statistical Analysis Package, University of California at Los Angeles, 1981 Version.

Figure 3. Illustration of calibrated grid viewed microscopically on a root surface of an experimental tooth. Plaque and/or calculus is depicted as circular areas within one or more grid squares.

FIGURE 3


Level of
Gingival
Margin
C.E.J.
Level of
Connective
Tissue
Attachment

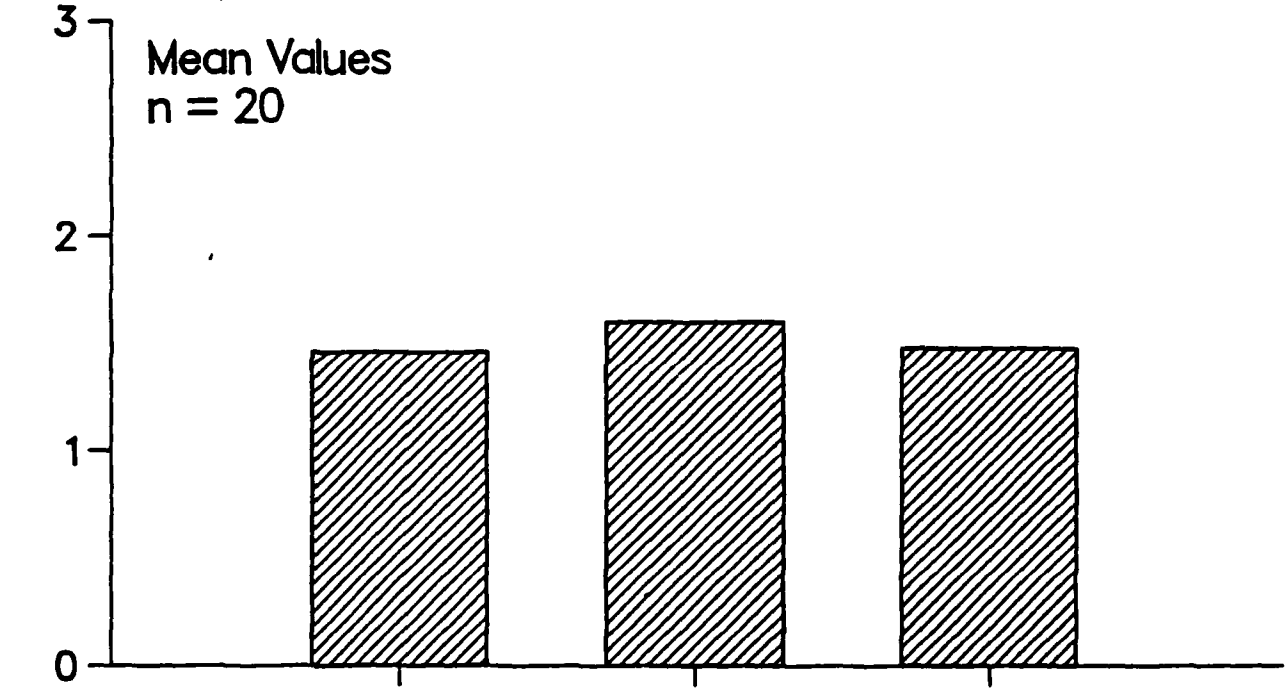
IV. RESULTS

Removal of plaque and calculus by open flap scaling and root planing was more efficient overall than a closed approach to scaling and root planing; however, this was not statistically significant at the 0.01 confidence level for deeper pocket depths (>3.0 mm). In no case was all plaque and calculus removed when open flaps and direct vision were used.

The results of the data, gathered by the different periodontal indices employed, express clinical observations in numerical values. The Gingival Index (GI) shows mean values of 1.46, 1.60 and 1.48 for the closed, open and controls respectively. The GI in the experimental open group ranged from 1.00 to 2.25. Both the closed and control groups had a GI range of 1.0 to 2.0. These results indicate at least mild inflammation present in all three groups (See Figure 4). The Plaque Index (PlI) shows mean values of 1.31, 1.28 and 1.46 in the closed, open and control groups respectively. The PlI range for both the closed and open groups was 0.50 to 2.50. The control group PlI ranged from 1.00 to 2.25 (See Figure 5). Generally, the teeth were invested with plaque; in no instances were any teeth clinically plaque free. The Periodontal Disease Index (PDI) of Ramfjord indicates a composite disease score for the periodontium using attachment loss as one of its main criteria. The high mean scores for all groups: closed - 4.9, open - 5.0; and control - 5.2 indicate considerable

Figure 4. *Graphic representation of mean group Gingival* Indices (G.I.). Sample size and range is also shown.

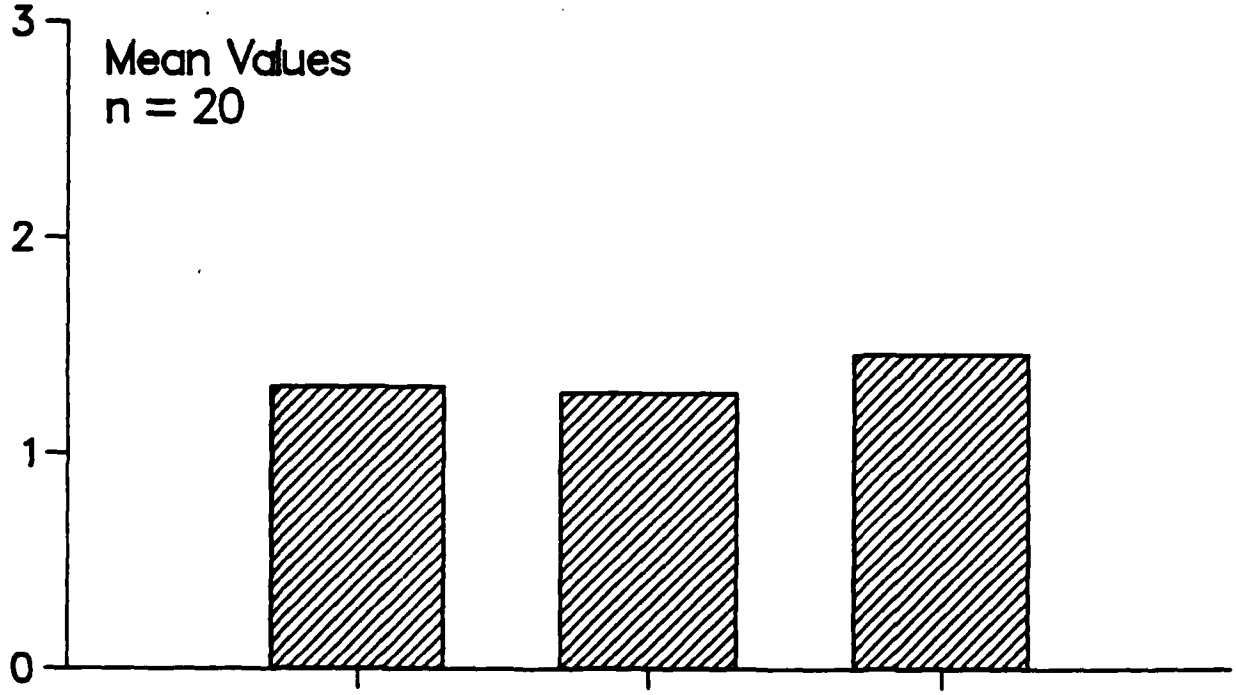
Figure 4
Gingival Index (GI)



Range:	Closed	Open	Control
Maximum	2.0	2.25	2.0
Minimum	1.0	1.00	1.0

Figure 5. Graphic representation of mean group Plaque Indices (PlI). Sample size and range is also shown.

Figure 5
Plaque Index (PI I)



Range:	Closed	Open	Control
Maximum	2.50	2.50	2.25
Minimum	0.50	0.50	1.00

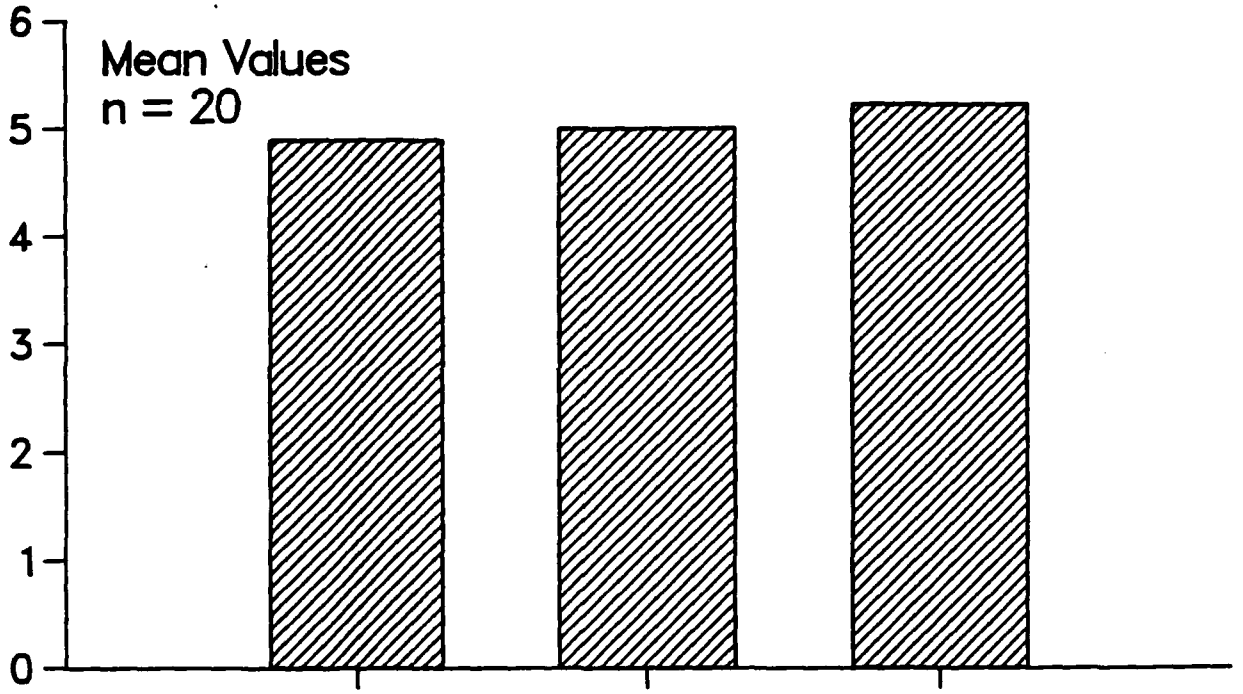
periodontal destruction on the test and control teeth. The PDI's ranged from 4 to 6 in the open group, 4 to 5 in the closed group and 5 to 5.5 in the control groups (See Figure 6). In summation, experimental and control teeth exhibited bacterial plaque, gingival inflammation, and attachment loss.

The time spent scaling and root planing the single rooted teeth and the number of curette strokes used to achieve a smooth hard surface is shown in Figures 7 and 8. The average time required to achieve a smooth root surface via a closed approach was 3 minutes 59 seconds. Surprisingly, in the open flap approach, the average time spent per tooth was 4 minutes, 24 seconds. For the closed approach, the required time to obtain a clinically smooth root surface ranged from 2 minutes, 37 seconds to 5 minutes, 20 seconds. In the open approach, time ranged from 2 minutes, 6 seconds to 7 minutes, 25 seconds (See Figure 7). The mean number of curette strokes utilized in both groups was 171. The minimum number of strokes used in the closed approach was 110 while the maximum number was 236 strokes. In the open approach, the number of strokes ranged from 65 to a maximum of 246 (See Figure 8).

The total or combined percentage comparison of plaque and calculus removal after scaling and root planing reveals a statistically significant improvement with the open procedure at the 0.01 level of significance (See Table 1). The mean difference between the two groups was a 20.51% better subgingival plaque and

Figure 6. Graphic representation of mean group Periodontal Disease Indices (PDI). The sample and size and range is also shown.

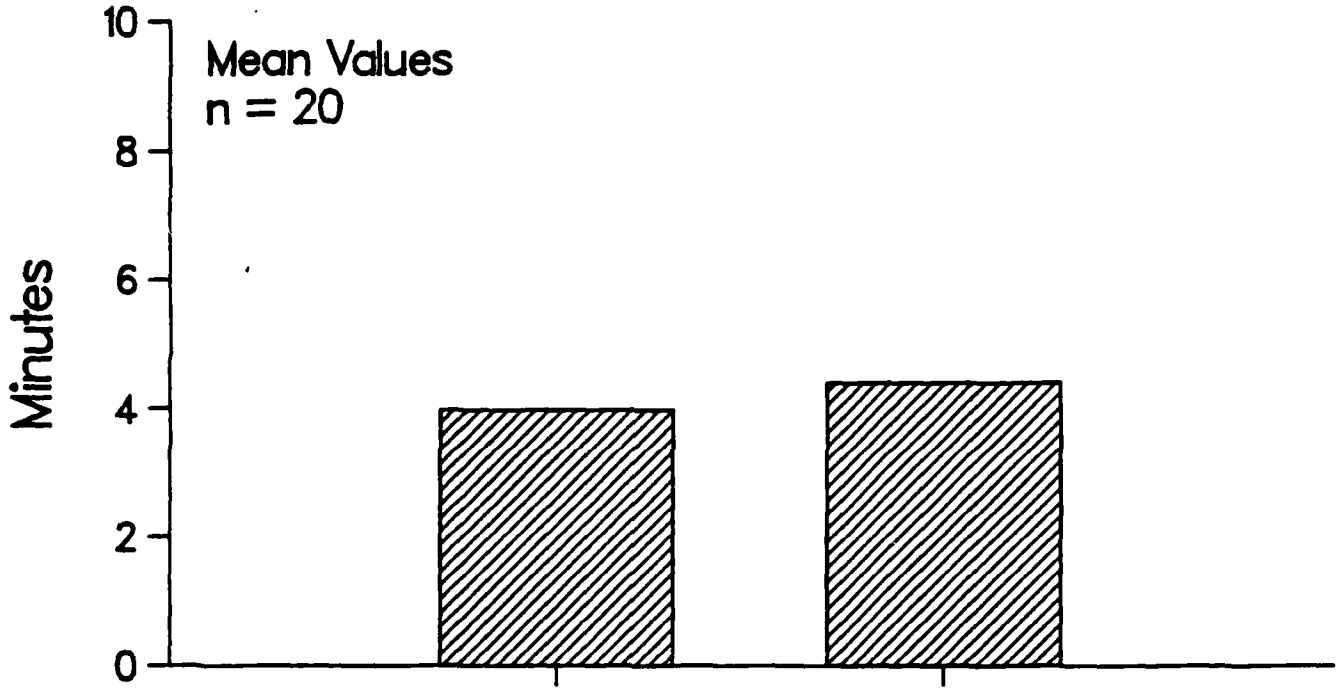
Figure 6
Periodontal Disease Index (PDI)



Range:	Closed	Open	Control
Maximum	5.0	6.0	5.5
Minimum	4.0	4.0	5.0

Figure 7. Graphic representation of the mean time needed to scale and root plane the experimental teeth to a smooth hard surface. Sample size and range is shown.

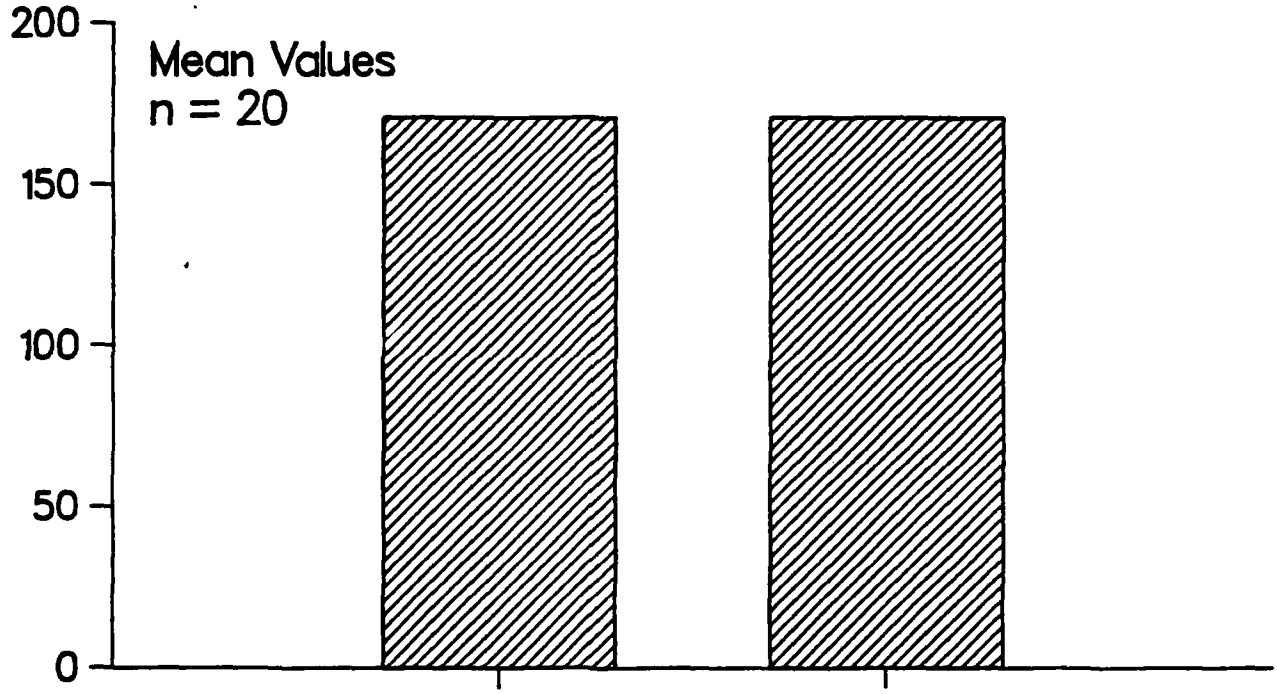
Figure 7
Time per Tooth



Range:	Closed	Open
Maximum	5 min 20 sec	7 min 25 sec
Minimum	2 min 37 sec	2 min 6 sec

Figure 8. Graphic representation of the number of curette strokes needed to scale and root plane the experimental root surfaces until they were smooth and hard. The sample size and range is shown.

Figure 8
Curette Strokes



Range:	Closed	Open
Maximum	236	246
Minimum	110	65

TABLE I

COMBINED PERCENTAGE COMPARISON

SYMBOL	SIGNIFICANCE LEVEL
*	.05
***	p<.001

GROUP NAME	GROUP MEAN	GROUP NO.	GROUP NAME	MEAN MEAN	MEAN DIFF	SEPARATE VARIANCE T T-VALUE	DF	P-VALUE
*1	45.87	2	*2	25.35	20.51	3.97	37.93	0.0003***
*1	45.87	3	*3	98.40	-52.54	-14.61	19.40	0.0001***
*2	25.35	3	*3	98.40	-73.06	-19.47	19.37	0.0001***

POOLED VARIANCE T T-VALUE	DF	P-VALUE
4.85	57	0.0001***
-12.41	57	0.0001***
-17.26	57	0.0001***

	GROUP 1 (Closed)	GROUP 2 (Open)	GROUP 3 (Control)
MEAN	45.865	25.350	98.405
STD.DEV.	15.998	16.701	1.647
R.E.S.D.	16.277	17.475	1.679
S.E.M.	3.577	3.734	0.368
MAXIMUM	75.800	57.300	100.000
MINIMUM	19.500	2.900	94.300
SAMPLE SIZE	20	20	20

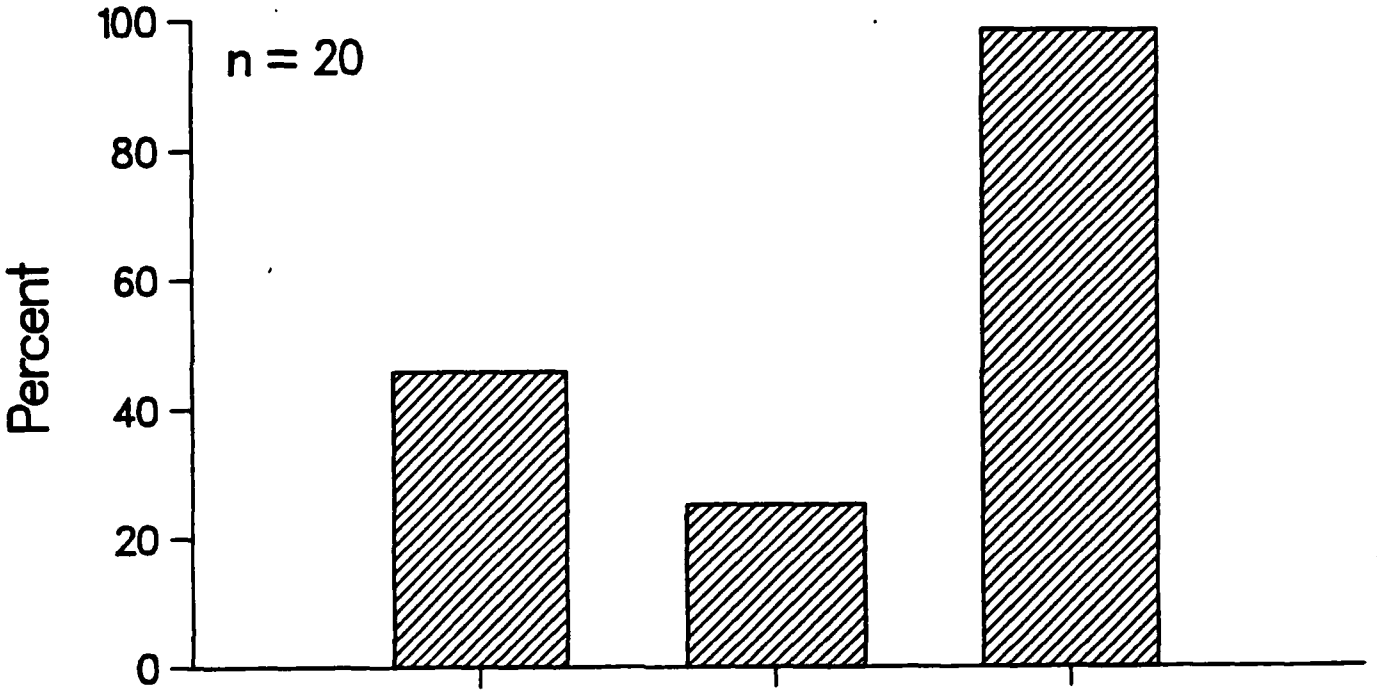
calculus removal with the open flap procedure. The mean for the closed group was 45.87% subgingival plaque and calculus remaining while the mean for the open group was 25.35% remaining. The controls, as expected, showed almost 100% of the root surface covered with plaque and/or calculus (See Figure 9). Standard deviations for both groups were high at 15.99% and 16.70% for the closed and open groups respectively. The closed group had maximum residual plaque and calculus of 75.80% and a minimum of 19.50%. The open flap procedure ranged from a maximum of 57.30% to a minimum of 2.90% residual plaque and calculus. For combined percentages and pocket depths in all groups sample size (n) = 20 per group.

In probing depth from 0-3.0 mm there was a statistically significant (P=0.01) improvement in plaque and calculus removal for the open flap procedure. The mean amount of plaque and calculus left on roots after closed and open procedures was 41.97% and 21.14% respectively (See Figure 10). The standard deviations (S.D.) for both groups was 14.48% and 13.34% for the closed and open procedures respectively (See Table 2). The residual plaque and calculus for the closed group ranged from 20.60% to 70.20%, while for the open group a range of 2.90% to 51.40% was noted. Controls approached 100% plaque and calculus on subgingival root surfaces.

For pocket depths 3.0 to 5.0 mm the removal of subgingival plaque and calculus was not statistically significant between the open or closed approaches (See Table 3). The mean residual plaque

Figure 9. Graphic representation of combined mean percentages for residual plaque and calculus of all pocket depths. Sample size and range is shown.

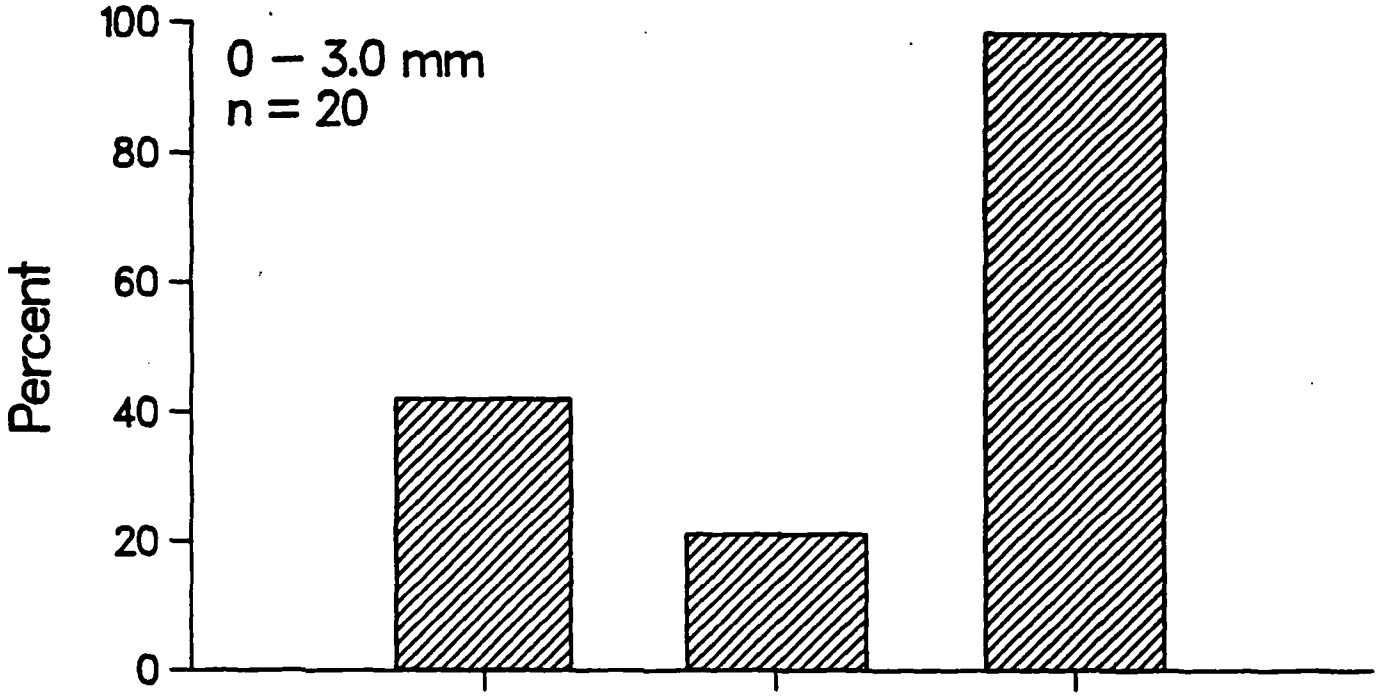
Figure 9
Mean Combined Percentages



Range:	Closed	Open	Control
Maximum	75.8	57.3	100
Minimum	19.5	2.9	94.3

Figure 10. Graphic representation of mean percentages of residual plaque and calculus in 0-3.0 mm pockets. The sample size and range is shown.

Figure10
Mean Percentage Plaque and Calculus
at Various Pocket Depths



Range:	Closed	Open	Control
Maximum	70.2	51.4	100
Minimum	20.6	2.9	92.3

TABLE 2

0 - 3.0 mm POCKET DEPTH

SYMBOL	SIGNIFICANCE LEVEL
*	.05
***	.001

GROUP NO.	GROUP NAME	MEAN	GROUP NO.	GROUP NAME	MEAN	MEAN DIFF	SEPARATE VARIANCE T T-VALUE	DF	P-VALUE
1	*1	41.96	2	*2	21.14	20.83	4.73	37.75	0.0001***
1	*1	41.96	3	*3	98.22	-56.26	-17.15	20.00	0.0001***
2	*2	21.14	3	*3	98.22	-77.08	-25.45	20.18	0.0001***

POOLED VARIANCE T T-VALUE	DF	P-VALUE
5.76	57	0.0001***
-15.54	57	0.0001***
-21.30	57	0.0001***

	GROUP 1 (Closed)	GROUP 2 (Open)	GROUP 3 (Control)
MEAN	41.965	21.135	98.220
STD.DEV.	14.476	13.338	2.352
R.E.S.D.	15.441	13.170	2.518
S.E.M.	3.237	2.983	0.526
MAXIMUM	70.200	51.400	100.000
MINIMUM	20.600	2.900	92.300
SAMPLE SIZE	20	20	20

and calculus left on root surfaces following treatment was 65.00% for the closed approach and 46.33% for the open approach (See Figure 11). The standard deviations were extremely high for both groups. For the closed approach, the S.D. was 28.61% and for the open approach 25.29%. Maximum residual plaque and calculus for 3.0 - 5.0 mm pocket depth in the closed group with n = 15 was 100% with total removal (0% remaining) found as a minimum. The open groups with n = 9 had a maximum of 77.30% residual plaque and calculus and 7.70% minimum range. Control root surfaces at the 3.0 to 5.0 mm level exhibited subgingival plaque and calculus over the entire root surface (99.6%) n = 16.

In pocket depths greater than 5.0 mm there was no statistically significant difference (P = 0.01) between the two approaches used to remove subgingival plaque and calculus (See Table 4). The mean residual subgingival plaque and calculus for the closed groups was 91.66% and 73.14% for the open flap approach (See Figure 12). The standard deviations varied considerably for the two groups. A standard deviation of 16.65% for the closed group and 25.28% for the open group were found. Range variations were somewhat similar. The closed group had a maximum of 100% and a minimum of 58.90% residual plaque and calculus in pockets greater than 5.0 mm pockets with n = 9. Using the open flap approach with n = 7 a maximum of 100% and a minimum of 44.40% were noted.

TABLE 3

3.0 - 5.0 mm POCKET DEPTH

SYMBOL	SIGNIFICANCE LEVEL
*	.05
**	.01
***	.001

GROUP NO.	GROUP NAME	MEAN	GROUP NO.	GROUP NAME	MEAN	MEAN DIFF	SEPARATE VARIANCE T T-VALUE	DF	P-VALUE
1	*1	65.00	2	*2	46.33	18.67	1.67	18.70	0.1125
1	*1	65.00	3	*3	99.60	-34.60	-4.68	14.04	0.0004***
2	*2	46.33	3	*3	99.60	-53.27	-6.32	8.02	0.0002***

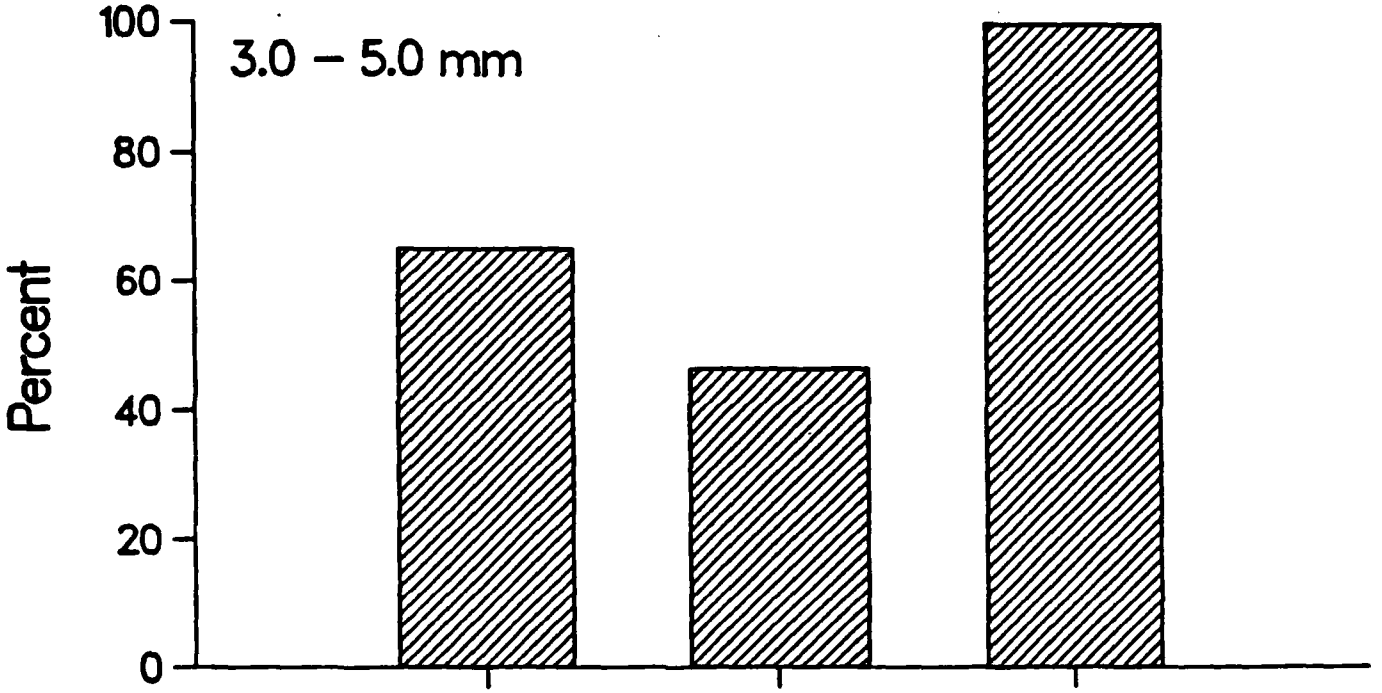
POOLED VARIANCE T T-VALUE	DF	P-VALUE
2.09	37	0.0435
-4.55	37	0.0001**
-6.04	37	0.0001**

	GROUP 1 (Closed)	GROUP 2 (Open)	GROUP 3 (Control)
MEAN	65.000	46.333	99.600
STD.DEV.	28.610	25.289	1.095
R.E.S.D.	29.942	29.472	0.906
S.E.M.	7.387	8.430	0.274
MAXIMUM	100.000	77.300	100.000
MINIMUM	0.000	7.700	96.600
SAMPLE SIZE	15	9	16

Figure 11. Graphic representation of mean percentages of residual plaque and calculus in 3.0 - 5.0 mm pockets. Range is shown.

Figure11

Mean Percentage Plaque and Calculus at Various Pocket Depths



Range:	Closed	Open	Control
Maximum	100	77.3	100
Minimum	0	7.7	96.6

TABLE 4

>5.0 mm POCKET DEPTH

SYMBOL	SIGNIFICANCE LEVEL
*	.05
**	.01
***	.001

GROUP NO.	GROUP NAME	MEAN	GROUP NO.	GROUP NAME	MEAN	MEAN DIFF	SEPARATE VARIANCE T T-VALUE	DF	P-VALUE
1	*1	91.66	2	*2	73.14	18.51	1.68	9.89	0.1252
1	*1	91.66	3	*3	98.23	-6.58	-1.17	8.51	0.2753
2	*2	73.14	3	*3	98.23	-25.09	-2.61	6.13	0.0394

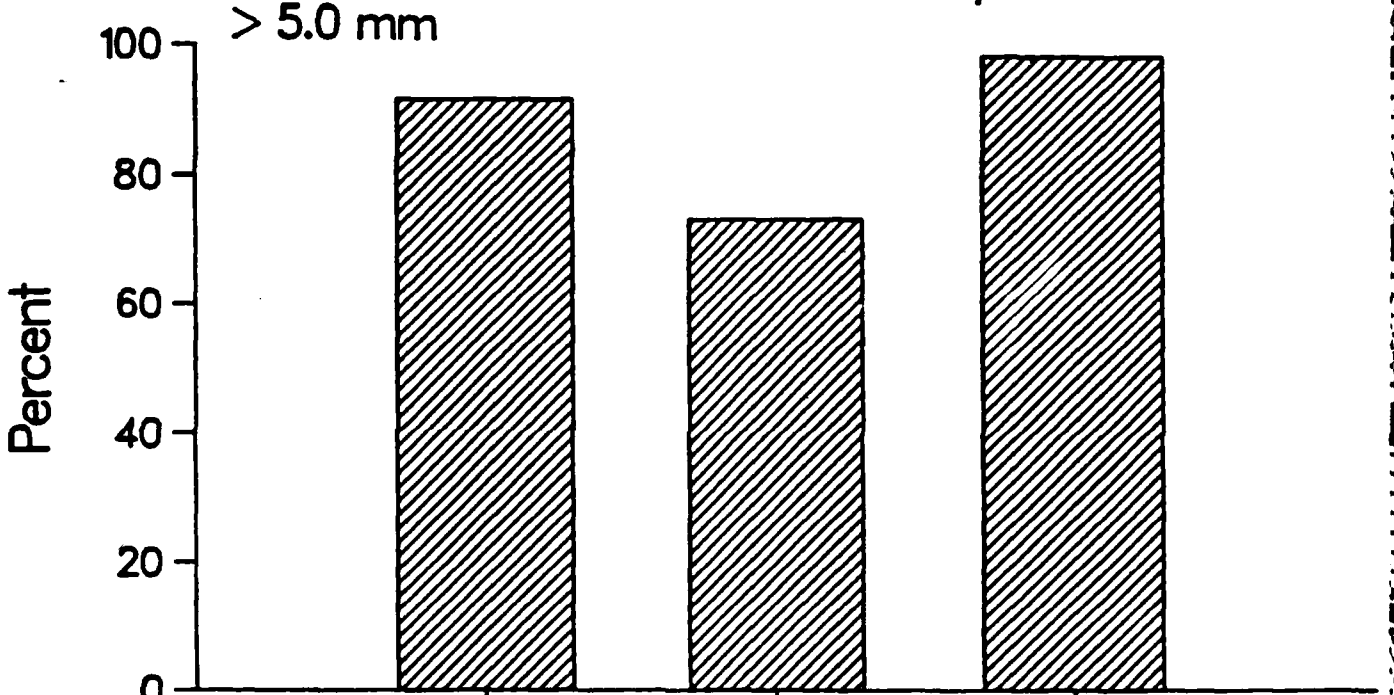
POOLED VARIANCE T T-VALUE	DF	P-VALUE
2.38	26	0.0250
-0.98	26	0.3354
-3.46	26	0.0019**

	GROUP 1 (Closed)	GROUP 2 (Open)	GROUP 3 (Control)
MEAN	91.656	73.143	98.231
STD.DEV.	16.653	25.280	3.558
R.E.S.D.	17.255	30.257	3.551
S.E.M.	5.551	9.555	0.987
MAXIMUM	100.000	100.000	100.000
MINIMUM	58.900	44.400	89.500
SAMPLE SIZE	9	7	13

Figure 12. Graphic representation of mean percentages of residual plaque and calculu in pockets greater than 5.0 mm. Range is shown.

Figure 12

Mean Percentage Plaque and Calculus at Various Pocket Depths



Range:	Closed	Open	Control
Maximum	100	100	100
Minimum	58.9	44.4	89.5

V. DISCUSSION

The main objective of the present study was to compare the effectiveness of subgingival scaling and root planing as a single therapeutic measure with that of subgingival scaling and root planing in conjunction with an open flap procedure. The findings show that in an overall comparison of the two methods, the open flap procedure gave more favorable results. However, in this study if root surfaces are broken down into the various depths as described by Waerhaug[14] and Rabbani,[43] i.e., less than 3.0 mm, 3.0 to 5.0 mm and greater than 5.0 mm, there was no statistically significant difference between the two methods in pocket depths greater than 3.0 mm. The effectiveness of subgingival scaling and root planing using either the closed approach or the open flap approach was not particularly efficacious in pocket depths from 3.0 to 5.0 mm and was extremely poor in pockets greater than 5.0 mm. In the present study, retention of plaque and calculus increased with pocket depth. In a study using 126 teeth, Sweeny et al.[50] found while scaling only versus scaling with a flap at various pocket depths that the percent tooth surface completely free of calculus showed 4.0 to 6.0 mm pockets to be 43% versus 76% and >6.0 mm pockets to be 32% versus 50%. These results are comparable to the present study which indicates an increased effectiveness of the same magnitude for the open flap approach. The results of many previous studies have also indicated that complete removal of plaque and calculus

from the root surfaces of teeth is difficult.[8,16,18,20,22,24,43] The findings in the present study are in agreement with these reports.

Schaffer[18] scaled six teeth and root planed twelve others via a closed approach and found that in all cases calculus remained on root surfaces following extraction. Calculus has been reported on root surfaces that felt clinically smooth after root planing.[20] Jones and O'Leary[22] visually inspected forty-eight proximal subgingival root planed surfaces after extraction and found nine surfaces (18.75%) of the teeth had remaining visible flecks of calculus. Although the surfaces were inspected visually, a high percentage of residual calculus was reported. Jones et al.[16] showed calculus removal was complete in only 26 of 54 teeth (48%) in their 1972 study. Considerable amounts of calculus were retained over some root surfaces which were left clinically "smooth." They noted that clinical assessment utilizing a probe or sharp explorer is often not accurate. Clinical assessment of treated root surfaces may indicate a root completely free of deposits or a root partly covered with a thin layer of burnished calculus. Rabbani et al.[43] in a study of 62 scaled teeth found 19.9% residual calculus on the mesial surfaces of anterior teeth. Also, in the latter study a direct relationship between depth of pockets and percent of residual calculus following scaling and root planing was found. Eaton et al.[24] in a recent study found no root surface to be

completely free of stained accretions following conventional root planing. Retained plaque and calculus on root surfaces ranged from 18.7% to 95.6%. Following surgical exposure of teeth and additional scaling and root planing, teeth were again stained. Stained root surfaces exhibited a minimum of 14.1% residual plaque and calculus and a maximum of 92.1%. The present research indicated minimum residual root surface deposits of 19.5% and a maximum of 75.8% with a closed procedure. Using an open flap approach, residual plaque and calculus ranged from 2.9% to 57.3%. These results are consistent with Eaton et al.[24] who found no root surface to be completely free of stained material. However, the results of the present study conflict in that the open approach reflected a consistently greater percentage of plaque and calculus free root surfaces.

In all pocket depths, the mean difference in effectiveness between the two techniques used was 20.51% with the open flap approach being more effective. Although the open flap procedure was more effective, 25.35% of all root surfaces exhibited subgingival deposits. In the closed approach, 45.87% of the root surfaces exhibited plaque or calculus. There was an 18.67% versus 18.51% (not statistically significant) mean difference between techniques favoring the open flap approach in the 3.0 - 5.0 mm and 5.0 mm and greater pocket depths respectively. Following scaling and root planing in the 3.0 - 5.0 mm pocket depths, the closed

method had mean residual deposits of 65% while the open group had 46.33%. When the pocket depth was greater than 5.0 mm, the closed approach mean residual deposits were 91.66% and the open flap approach showed a mean of 73.14%.

Pihlstrom et al.[44] stated "scaling and root planing used without an accompanying flap procedure is not easier or less demanding." Longitudinal studies in which closed scaling and root planing were shown to be clinically effective required multiple hours of therapy over multiple appointments. Hill et al.[32] and Pihlstrom et al.[32] took 5-8 hours over a course of 3-8 appointments to scale and root plane patients. In the Hill et al.[32] study, additional time for scaling and root planing was needed after a dental hygienist had utilized 4-6 appointments for scaling and oral hygiene instruction. The present study noted a mean time value utilized per tooth for the closed procedure of 4 minutes with the open approach requiring 4 minutes, 24 seconds per tooth. The extra time spent during the open flap approach was required to remove the tenacious, burnished calculus deposits visualized. Utilizing a closed approach, the time ranged from 2 minutes, 37 seconds to 5 minutes, 20 seconds. Using an open flap approach, the time ranged from 2 minutes, 6 seconds to 7 minutes, 25 seconds. In comparison, Badersten et al.[29-30] using hand instruments, had times ranging from 4.7 to 8.0 minutes of instrumentation per tooth with a closed approach at the initial

appointment. The hygienists in the study by Stambaugh et al.[23] spent between 25 and 39 minutes per posterior tooth in order to achieve roots that were "free of detectable roughness." Time required to obtain a clinically acceptable root surface apparently varies with the operator and the method used to evaluate root smoothness.

The mean number of curette strokes utilized per tooth for both the closed and open approaches in order to achieve a smooth hard surface was 171. The number of strokes required to achieve clinical smoothness with the closed approach was 110 to 236. In the open flap approach, the number of curette strokes required ranged from 65 to 246. The number of strokes used was clinically related to the amount of residual calculus on the root surfaces. This parameter indicates the thoroughness employed and the extent to which the operator must go in order to achieve the clinical root smoothness desired. In this study when subgingival scaling or root planing was used as a treatment procedure alone, it did not offer any advantage in terms of time or number of strokes required to achieve clinical smoothness.

Eaton et al.[24] (1985) in no instance found a totally nonstainable root surface, despite the fact that only the readily accessible buccal root surfaces of anterior teeth were evaluated. Eaton et al.[24] suggested three important clinical factors that may contribute to the limitations of subgingival plaque and calculus

removal noted in previous studies and the present study. First, even under optimal conditions, surgical exposure of root surfaces with the attainment of totally plaque and calculus free root surfaces cannot be ensured. Greater time and more attention to detail may increase clinical effectiveness. Second, preliminary histologic findings suggest that stained material left on root surfaces represents deposits of bacterial plaque, pellicle or calculus. However, when reviewing stained treated root surfaces the possibility that root surface roughness or that biologically clean root surfaces might retain the methylene blue stain cannot be ruled out. In the present study the roots generally appeared clinically smooth and free of debris at the time of extraction. After staining and storage, however, there was satin-like blue areas indicative of plaque retention apparent on all roots. Finally, Eaton et al.[24] suggested that there was no demonstrable correlation between the area of root surface stained after instrumentation and pocket depths, whether using a closed or an open approach. The findings in the present study and those by Waerhaug[24] and Rabbani et al.[43] disagree with the latter findings. These studies indicate a direct correlation between pocket depth and residual root surface deposits.

An additional limitation in the present study that could have limited root treatment in the open approach was the fact that no initial preparation, i.e., scaling and root planing, was done

prior to the surgical flap reflection. Unlike standard therapy where initial preparation precedes surgical treatment, surgical therapy in this study was associated with a greater amount of surgical hemorrhage. Hence, even with adequate suction and irrigation, bleeding from the granulation tissues often obscured the surgical field during the root planing.

Another study limitation in technique was the difficulty found in focusing the stereomicroscope in and out with the micrometer disc in place. Focusing changed the orientation of observed plaque and calculus from one counted square to the adjacent square. On a small root surface such as a mandibular anterior tooth this effect could increase the percentage of retained plaque and calculus recorded. This factor was limited by repeating the readings three different times.

Finally, statistically as pocket depth increased, the n or sample size decreased. There was a significant decrease of sample size in pocket depths greater than 5.0 mm. There were only 7 teeth with pocket depths greater than 5.0 mm in the open flap approach group (See Table 4). When considering the n (sample size), differences in n affect the variance and the difference in absolute means. The lack of significance between groups for pocket depths greater than 3.0 mm is a function of sample size and the overlapping of standard deviations that occurred in the small sample groups. The latter occurred as a result of decreased n values. Future

studies in this area should insure a large sample size at every incremental pocket depth so as not to skew statistical results.

Several important factors must be considered when making a decision for or against performing surgery. Pihlstrom et al.[44] noted that most studies report either frequency data or means (Hill, et al.[32] Pihlstrom et al.[33]) of clinical parameters and this type of data analysis does not reveal individual patient variation. Pihlstrom et al.[44] and Badersten et al.[30] both reported patients in which progression of the disease occurred. Lindhe et al.[35] noted that recurrence of disease could be found in some patients. When recurrence is evident, it has usually been attributed to ineffective prophylactic measures or to insufficient debridement during active treatment (Waerhaug).[12] Stambaugh et al.[23] in contrast to Badersten, et al.[31] suggested that it may not be practical or possible to obtain a plaque and calculus free root surface in one instrumentation session when pocket depth is greater than 4.0 mm. Stambaugh also suggested a need for further investigation into the role of tooth morphology, furcations and tissue tone, topics not addressed in Badersten et al.[29-31] Lang [51] (1985), in a review of non-surgical periodontal therapy, notes that in the absence of effective oral hygiene, non-surgical periodontal therapy only retards the progression of destructive periodontitis, most likely by altering the subgingival microenvironment. Subgingival attached plaque is

continuous with the supragingival plaque, hence the need for effective removal of supra and subgingival microbial deposits. If plaque and calculus are retained on the root surface, periodontopathic flora can proliferate causing continued attachment destruction. The present study found the greatest accumulation of plaque and calculus at the CEJ, mesial and distal grooves, and pits or defects in the root surface. All these areas are difficult to detect by conventional means.

Eaton et al.[24] suggested that absolute root surface "cleanliness" may not be as critical as hitherto believed. Our own criteria for success however is the elimination of bacterial irritants on the root in order to provide a biologically acceptable smooth clean surface where gingival and periodontal healing can take place. The data reported in the present study as well as in publications by Lindhe et al.[45] Badersten et al.[29-31] Hill et al.[32] Pihlstrom et al.[44] and Lang[51] should not be interpreted as suggesting that surgical exposure of deep pockets is a superfluous component of periodontal therapy. Lindhe et al.[45] state that "the critical determinant in periodontal therapy is not the technique per se that is used for the elimination of the subgingival infection but that debridement of the root surface is properly performed. Based on previous studies and the present study, the open flap approach appears to be the technique of choice for optimal removal of subgingival plaque and calculus.

Future studies need to shed some light on what degree of residual deposits can remain on a root surface without causing undue detrimental effects to the periodontium. The host tolerates plaque and may heal in the presence of plaque but the extent to which this takes place is not known. Further study using a combination of hand and ultrasonic instruments, polishing or the use of a prophy-jet on root surfaces, or chemical treatment of root surfaces can increase our knowledge of acceptably "clean" root surfaces. The present study indicates that with the current state of technology, the total removal of subgingival plaque and calculus is not clinically feasible at any pocket depth. Better methods need to be developed for accurately determining and accomplishing the end point of thorough root debridement.

VI. SUMMARY

The present study found an overall increased thoroughness of subgingival plaque and calculus removal with an open flap approach versus a closed approach. The results favor the open flap approach showing a mean value of residual plaque and calculus of 25.35% compared to 45.87% for the closed approach. This was a difference of 20.51% which was statistically significant at the $p<.001$ level.

In this study, there was considerable variance within group ranges. Due to this variance there was no statistical difference in plaque and calculus removed in pocket depths 3.0 mm - 5.0 mm and 5.0 mm or greater in depth via the open or the closed approach. However, the open approach was 18% more efficient in the removal of subgingival plaque and calculus compared to the closed approach.

Clinical parameters reveal no statistical advantage of so-called "nonsurgical" and "surgical" treatment methods in periodontal pockets 3.0 mm or greater. However, the mean increase of 18% subgingival plaque and calculus removal via the open flap approach cannot be ignored. Additional considerations in selecting a specific method for treatment of periodontitis include a wide variety of factors which have a major influence on the mode of therapy according to Pihlstrom et al.[44] and Lindhe et al[45] Accessibility is one of the most critical considerations. In addition, there is a wide variety of skill among clinicians and it

should not be assumed that closed subgingival scaling and root planing is performed equally well by all clinicians. It was noted in this study that a small group of teeth treated by the supervising professor had less retained subgingival plaque and calculus than the majority of teeth treated by the primary investigator. Increased skill may well develop with time and experience.

Complete removal of subgingival plaque and calculus is the goal of periodontal therapy. It is not known what amount of residual deposits can remain on root surfaces without actively contributing to further periodontal breakdown. Therefore, reflection of a flap for accessibility may be the most reliable method available to visualize root surfaces to insure optimal subgingival plaque and calculus removal. Perhaps greater accessibility will ultimately accomplish our goal of thorough root debridement.

APPENDICES

A-1

NAME: Sh
TOOTH #: 10
GROUP: Closed

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					16	<3mm	8	8	8		14
MESIAL					16	3-5mm	2	2	2		2
	10		9	10	16	>5mm					
					13	<3mm	0	1	1		13
DISTAL					13	3-5mm					
	0		1	1	13	>5mm					
					6	<3mm	0	0	0		6
BUCCAL					6	3-5mm					
	0		0	0	6	>5mm					
					4	<3mm	2	2	2		4
LINGUAL					4	3-5mm					
	2		2	2	4	>5mm					
						<3mm	10	11	11		37
TOTAL						3-5mm	2	2	2		2
	12		12	13	39	>5mm					

NAME: Sh
TOOTH #: 9
GROUP: Closed

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					29	<3mm	5	5	5		15
MESIAL					29	3-5mm	3	3	3		10
	12		12	12	23	>5mm	4	4	4		4
					20	<3mm	6	6	6		12
DISTAL					20	3-5mm	6	6	6		7
	13		13	13	20	>5mm	1	1	1		1
					21	<3mm	3	3	3		13
BUCCAL					21	3-5mm	4	4	4		7
	7		7	7	21	>5mm					
					17	<3mm	4	4	4		9
LINGUAL					17	3-5mm	4	4	4		6
	10		10	10	17	>5mm	2	2	2		2
						<3mm	18	18	18		49
TOTAL						3-5mm	17	17	17		30
	42		42	42	87	>5mm	7	7	7		7

A-2

NAME: Sh
TOOTH #: 23
GROUP: Closed

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					12	<3mm	5		5	5	12
MESIAL					12	3-5mm					
	5		5	5	12	>5mm					
					8	<3mm	1		1	1	8
DISTAL					8	3-5mm					
	1		1	1	8	>5mm					
					8	<3mm	0		0	0	8
BUCCAL					8	3-5mm					
	0		0	0	8	>5mm					
					6	<3mm	1		1	1	6
LINGUAL					6	3-5mm					
	1		1	1	6	>5mm					
						<3mm	7		7	7	34
TOTAL						3-5mm					
	7		7	7	34	>5mm					

NAME: Sh
TOOTH #: 24
GROUP: Closed

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					12	<3mm	1		2	1	12
MESIAL					11	3-5mm					
	1		2	1	12	>5mm					
					15	<3mm	13		13	13	15
DISTAL					15	3-5mm					
	13		13	13	15	>5mm					
					6	<3mm	3		3	3	6
BUCCAL					6	3-5mm					
	3		3	3	6	>5mm					
					6	<3mm	3		3	3	6
LINGUAL					6	3-5mm					
	3		3	3	6	>5mm					
						<3mm	20		21	20	39
TOTAL						3-5mm					
	20		21	20	39	>5mm					

A-3

NAME: Py
TOOTH #: 8
GROUP: Closed

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					11	<3mm	3	3	3	3	11
MESIAL					11	3-5mm					
	3		3	3	11	>5mm					
					17	<3mm	4	4	4	12	
DISTAL					17	3-5mm	5	5	5	5	
	9		9	9	17	>5mm					
					22	<3mm	9	10	9	15	
BUCCAL					22	3-5mm	6	6	6	7	
	15		16	15	22	>5mm					
					24	<3mm	9	9	9	9	
LINGUAL					24	3-5mm	6	6	6	6	
	24		23	24	24	>5mm	9	8	9	9	
						<3mm	25	26	25	47	
TOTAL						3-5mm	17	17	17	18	
	51		51	51	74	>5mm	9	8	9	9	

NAME: Py
TOOTH #: 7
GROUP: Closed

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					15	<3mm	1	2	1	12	
MESIAL					15	3-5mm	3	3	3	3	
	4		5	4	15	>5mm					
					8	<3mm	0	0	0	8	
DISTAL					8	3-5mm					
	0		0	0	8	>5mm					
					9	<3mm	3	4	3	9	
BUCCAL					9	3-5mm					
	3		4	3	9	>5mm					
					11	<3mm	8	8	8	11	
LINGUAL					11	3-5mm					
	8		8	8	11	>5mm					
						<3mm	12	14	12	40	
TOTAL						3-5mm	3	3	3	3	
	15		17	15	43	>5mm					

A-4

NAME: Py
TOOTH #: 6
GROUP: Closed

SURFACE	Sq. with PC 1	2	3	# Sq	SURFACE	Sq. with PC 1	2	3	# Sq
				12	<3mm	5	6	5	12
MESIAL				12	3-5mm				
	5	6	5	12	>5mm				
				17	<3mm	9	9	9	10
DISTAL				17	3-5mm	0	0	0	1
	9	9	10	17	>5mm				
				12	<3mm	2	1	1	12
BUCCAL				11	3-5mm				
	2	1	1	12	>5mm				
				14	<3mm	7	7	7	9
LINGUAL				14	3-5mm	2	2	2	5
	9	9	9	14	>5mm				
					<3mm	23	23	23	49
TOTAL					3-5mm	2	2	2	6
	25	25	25	55	>5mm				

NAME: Py
TOOTH #: 5
GROUP: Closed

SURFACE	Sq. with PC 1	2	3	# Sq	SURFACE	Sq. with PC 1	2	3	# Sq
				21	<3mm	11	11	12	21
MESIAL				21	3-5mm				
	11	11	12	21	>5mm				
				16	<3mm	6	7	6	16
DISTAL				17	3-5mm				
	6	7	6	16	>5mm				
				6	<3mm	0	1	0	6
BUCCAL				6	3-5mm				
	0	1	0	6	>5mm				
				9	<3mm	5	6	5	9
LINGUAL				9	3-5mm				
	5	6	5	9	>5mm				
					<3mm	22	25	23	52
TOTAL					3-5mm				
	22	25	23	52	>5mm				

A-5

NAME: Co
TOOTH #: 7
GROUP: Closed

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					28	<3mm	4				15
MESIAL					28	3-5mm	5				10
	17	15	16	28		>5mm	3				3
					28	<3mm	4				12
DISTAL					28	3-5mm	5				8
	17	17	16	28		>5mm	7	8	7		8
					21	<3mm	3				9
BUCCAL					21	3-5mm	2	1	2		6
	5	4	4	21		>5mm	0				6
					15	<3mm	6	7	6		9
LINGUAL					15	3-5mm	6				6
	12	11	12	15		>5mm					
						<3mm	17	17	17		45
TOTAL						3-5mm	18	17	17		30
	51	47	48	92		>5mm	10	11	10		17

NAME: Co
TOOTH #: 6
GROUP: Closed

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					21	<3mm	7	8	8		19
MESIAL					21	3-5mm	2				2
	11	12	11	21		>5mm					
					34	<3mm	19	18	18		21
DISTAL					34	3-5mm	8				12
	27	28	27	34		>5mm	1				1
					16	<3mm	5	6	6		12
BUCCAL					16	3-5mm	4				4
	11	11	11	16		>5mm					
					14	<3mm	6	5	5		9
LINGUAL					14	3-5mm	3				5
	5	6	6	14		>5mm					
						<3mm	37	37	37		61
TOTAL						3-5mm	17	17	17		23
	54	57	59	85		>5mm	1	1	1		1

A-6

NAME: Co
TOOTH #: 8
GROUP: Closed

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					19	<3mm	5	6	5	16
MESIAL					19	3-5mm	2	2	2	3
	8	7	7		19	>5mm				
					22	<3mm	5	6	5	15
DISTAL					21	3-5mm	4	3	4	7
	7	6	6		22	>5mm				
					12	<3mm	6	5	6	11
BUCCAL					12	3-5mm	1	1	1	1
	7	6	7		12	>5mm				
					14	<3mm	9	9	9	9
LINGUAL					15	3-5mm	2	3	3	6
	12	12	12		14	>5mm				
						<3mm	25	26	25	51
TOTAL						3-5mm	9	9	10	17
	34	31	32		67	>5mm				

NAME: Ho
TOOTH #: 8
GROUP: Closed

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					11	<3mm	5	5	5	10
MESIAL					9	3-5mm				
	5	6	5		9	>5mm				
					27	<3mm	10	10	10	15
DISTAL					27	3-5mm	8	8	8	10
	19	20	19		27	>5mm	2	2	2	2
					10	<3mm	7	7	7	10
BUCCAL					11	3-5mm				
	7	7	7		10	>5mm				
					20	<3mm	11	11	11	12
LINGUAL					19	3-5mm	6	5	6	6
	19	18	19		20	>5mm	2	2	2	2
					68	<3mm	33	33	33	47
TOTAL					66	3-5mm	14	13	14	16
	50	51	50		66	>5mm	4	4	4	4

A-7

NAME: Jo
TOOTH #: 7
GROUP: Closed

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					6	<3mm	2		2	3	6
MESIAL					6	3-5mm					
	2		2	3	6	>5mm					
					9	<3mm	4		4	5	9
DISTAL					10	3-5mm					
	4		5	5	10	>5mm					
					6	<3mm	5		5	5	6
BUCCAL					6	3-5mm					
	5		5	5	6	>5mm					
					9	<3mm	4		3	4	9
LINGUAL					9	3-5mm					
	4		3	4	9	>5mm					
					30	<3mm	15		14	17	30
TOTAL					31	3-5mm					
	15		15	17	31	>5mm					

NAME: Jo
TOOTH #: 8
GROUP: Closed

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					11	<3mm	5		5	5	10
MESIAL					10	3-5mm					
	5		5	5	9	>5mm					
					13	<3mm	3		3	3	11
DISTAL					11	3-5mm					
	3		3	5	12	>5mm					
					8	<3mm	1		1	1	8
BUCCAL					7	3-5mm					
	1		1	1	8	>5mm					
					10	<3mm	4		4	4	10
LINGUAL					8	3-5mm					
	4		4	4	10	>5mm					
					42	<3mm	13		13	13	39
TOTAL					36	3-5mm					
	13		13	15	39	>5mm					

A-8

NAME: Ho
TOOTH #: 7
GROUP: Closed

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					28	<3mm	6	7	6	15	
MESIAL					28	3-5mm	10	9	10	10	
	19	18	18		27	>5mm	3	3	3	3	
					22	<3mm	9	8	9	15	
DISTAL					21	3-5mm	6	5	6	7	
	15	14	14		21	>5mm					
					12	<3mm	4	4	4	9	
BUCCAL					12	3-5mm	3	3	3	3	
	7	8	7		12	>5mm					
					15	<3mm	2	3	2	9	
LINGUAL					15	3-5mm	6	6	6	6	
	9	8	8		15	>5mm					
						<3mm	21	22	21	48	
TOTAL						3-5mm	25	23	24	26	
	50	48	47		76	>5mm	3	3	3	3	

NAME: Py
TOOTH #: 4
GROUP: Closed

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					28	<3mm	13	14	13	21	
MESIAL					28	3-5mm	6	7	6	7	
	19	20	19		28	>5mm					
					12	<3mm	4	5	5	12	
DISTAL					12	3-5mm					
	4	5	5		12	>5mm					
					12	<3mm	4	4	4	12	
BUCCAL					12	3-5mm					
	4	4	4		12	>5mm					
					14	<3mm	6	5	6	9	
LINGUAL					15	3-5mm	3	2	2	5	
	8	9	8		14	>5mm					
						<3mm	27	28	28	44	
TOTAL						3-5mm	9	9	8	12	
	35	38	36		66	>5mm					

A-9

NAME: Va
TOOTH #: 10
GROUP: Closed

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					14	<3mm	3		2	3	12
MESIAL					14	3-5mm					2
	3		2	3	14	>5mm					
					7	<3mm	1		1	1	7
DISTAL					8	3-5mm					
	1		1	1	8	>5mm					
					10	<3mm	3		3	3	10
BUCCAL					10	3-5mm					
	3		4	3	10	>5mm					
					9	<3mm	1		2	1	9
LINGUAL					9	3-5mm					
	1		2	1	9	>5mm					
						<3mm	8		8	8	38
TOTAL					1	3-5mm					2
	8		9	8	41	>5mm					

NAME: Va
TOOTH #: 9
GROUP: Closed

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					18	<3mm	2		2	2	12
MESIAL					18	3-5mm	1		2	1	6
	4		3	4	18	>5mm					
					20	<3mm	3		2	3	14
DISTAL					19	3-5mm	4		5	4	7
	7		6	7	21	>5mm					
					8	<3mm	2		2	2	8
BUCCAL					8	3-5mm					
	2		2	2	8	>5mm					
					21	<3mm	2		2	2	9
LINGUAL					21	3-5mm	2		2	2	6
	9		9	9	21	>5mm	5		4	4	6
						<3mm	9		8	9	43
TOTAL						3-5mm	7		9	7	19
	22		20	22	67	>5mm	5		4	4	6

A-10

NAME: G1
TOOTH #: 7
GROUP: Closed

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					14	<3mm	5	6	5	14
MESIAL					14	3-5mm				
	5	6	5		14	>5mm				
					21	<3mm	6	5	6	14
DISTAL					20	3-5mm	3	2	3	6
	9	9	9		21	>5mm				
					9	<3mm	6	6	6	9
BUCCAL					9	3-5mm				
	6	6	6		9	>5mm				
					12	<3mm	4	3	4	6
LINGUAL					12	3-5mm	4	4	4	4
	10	9	10		12	>5mm	2	2	2	2
						<3mm	21	20	21	43
TOTAL						3-5mm	7	6	7	10
	30	30	30		56	>5mm	2	2	2	2

NAME: G1
TOOTH #: 8
GROUP: Closed

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					12	<3mm	3	4	3	21
MESIAL					12	3-5mm				
	3	4	3		12	>5mm				
					28	<3mm	5	5	5	15
DISTAL					27	3-5mm	3	3	3	8
	4	3	4		28	>5mm	4	3	4	4
					4	<3mm	1	0	1	4
BUCCAL					4	3-5mm				
	1	0	1		4	>5mm				
					13	<3mm	2	2	2	9
LINGUAL					12	3-5mm	3	2	2	3
	6	6	6		13	>5mm	1	1	1	1
						<3mm	11	11	11	40
TOTAL						3-5mm	6	5	5	11
	14	13	14		57	>5mm	5	4	5	5

A-11

NAME: Sh
TOOTH #: 26
GROUP: Open

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					10	<3mm	1	1	1		10
MESIAL					10	3-5mm					
	1		1	1	10	>5mm					
					17	<3mm	0	0	0		15
DISTAL					17	3-5mm	0	0	0		2
	0		0	0	18	>5mm					
					9	<3mm	0	0	0		9
BUCCAL					9	3-5mm					
	0		0	0	9	>5mm					
					6	<3mm	3	3	3		6
LINGUAL					6	3-5mm					
	3		3	3	6	>5mm					
						<3mm	4	4	4		40
TOTAL						3-5mm	0	0	0		2
	4		4	4	42	>5mm	0	0	0		

NAME: Sh
TOOTH #: 25
GROUP: Open

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					13	<3mm	1	1	1		13
MESIAL					13	3-5mm					
	1		1	1	13	>5mm					
					6	<3mm	0	0	0		6
DISTAL					6	3-5mm					
	0		0	0	6	>5mm					
					6	<3mm	2	2	2		6
BUCCAL					6	3-5mm					
	2		2	2	6	>5mm					
					7	<3mm	3	2	3		7
LINGUAL					7	3-5mm					
	3		2	3	7	>5mm					
						<3mm	6	5	6		32
TOTAL						3-5mm					
	6		5	6	32	>5mm					

A-12

NAME: Sh
TOOTH #: 8
GROUP: Open

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					26	<3mm	4	4	4		15
MESIAL					27	3-5mm	6	6	6		9
	13		13	13	26	>5mm	3	3	3		3
					23	<3mm	3	3	3		12
DISTAL					23	3-5mm	4	4	4		8
	10		10	10	24	>5mm	3	3	3		4
					6	<3mm	2	2	2		6
BUCCAL					6	3-5mm					
	2		1	2	6	>5mm					
					25	<3mm	3	3	3		12
LINGUAL					25	3-5mm	7	7	7		8
	14		14	14	25	>5mm	4	4	4		5
						<3mm	12	12	12		45
TOTAL						3-5mm	17	17	17		25
	39		38	39	80	>5mm	10	10	10		12

NAME: Sh
TOOTH #: 7
GROUP: Open

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					7	<3mm	2	1	2		7
MESIAL					7	3-5mm					
	2		1	2	7	>5mm					
					15	<3mm	5	5	5		15
DISTAL					15	3-5mm					
	5		5	5	15	>5mm					
					3	<3mm	0	0	0		3
BUCCAL					3	3-5mm					
	0		0	0	3	>5mm					
					9	<3mm	3	3	3		9
LINGUAL					9	3-5mm					
	3		3	3	9	>5mm					
						<3mm	10	9	10		34
TOTAL						3-5mm					
	10		9	10	34	>5mm					

A-13

NAME: So
TOOTH #: 25
GROUP: Open

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					13	<3mm	3	3	3		13
MESIAL					12	3-5mm					
	3		3	3	13	>5mm					
					10	<3mm	2	3	2		10
DISTAL					10	3-5mm					
	2		3	2	10	>5mm					
					4	<3mm	0	0	0		4
BUCCAL					4	3-5mm					
	0		0	0	4	>5mm					
					2	<3mm	0	0	0		2
LINGUAL					2	3-5mm					
	0		0	0	2	>5mm					
						<3mm	5	6	5		29
TOTAL						3-5mm					
	5		6	5	29	>5mm					

NAME: So
TOOTH #: 23
GROUP: Open

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					17	<3mm	4	4	4		17
MESIAL					17	3-5mm					
	4		4	4	17	>5mm					
					14	<3mm	3	2	3		14
DISTAL					14	3-5mm					
	3		2	3	14	>5mm					
					4	<3mm	1	0	1		4
BUCCAL					4	3-5mm					
	1		0	1	4	>5mm					
					4	<3mm	1	1	1		4
LINGUAL					4	3-5mm					
	1		1	1	4	>5mm					
						<3mm	9	7	9		39
TOTAL						3-5mm					
	9		7	5	39	>5mm					

A-14

NAME: So
TOOTH #: 26
GROUP: Open

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					16	<3mm	6	6	6		16
MESIAL					17	3-5mm					
	6		7	6	16	>5mm					
					11	<3mm	1	1	1		11
DISTAL					11	3-5mm					
	1		2	1	11	>5mm					
					4	<3mm	0	0	0		4
BUCCAL					4	3-5mm					
	0		0	0	4	>5mm					
					6	<3mm	0	0	0		6
LINGUAL					6	3-5mm					
	0		0	0	6	>5mm					
						<3mm	7	7	7		37
TOTAL						3-5mm					
	7		9	7	37	>5mm					

NAME: So
TOOTH #: 24
GROUP: Open

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					10	<3mm	1	1	1		10
MESIAL					10	3-5mm					
	1		1	1	10	>5mm					
					15	<3mm	0	0	0		15
DISTAL					15	3-5mm					
	0		0	0	15	>5mm					
					6	<3mm	0	0	0		6
BUCCAL					6	3-5mm					
	0		0	0	6	>5mm					
					3	<3mm	0	0	0		3
LINGUAL					3	3-5mm					
	0		0	0	3	>5mm					
						<3mm	1	1	1		34
TOTAL						3-5mm					
	1		1	1	34	>5mm					

A-15

NAME: Py
TOOTH #: 12
GROUP: Open

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					44	<3mm	9	9	9		21
MESIAL					43	3-5mm	11	10	10		14
	23		22	22	43	>5mm	3	3	3		8
					43	<3mm	7	7	7		21
DISTAL					44	3-5mm	9	9	9		14
	21		22	21	43	>5mm	5	6	5		8
					17	<3mm	3	3	3		9
BUCCAL					17	3-5mm	4	3	4		6
	8		7	8	17	>5mm	1	1	1		2
					18	<3mm	4	3	4		9
LINGUAL					18	3-5mm	1	2	2		6
	7		7	7	18	>5mm	2	2	2		3
						<3mm	23	22	23		60
TOTAL						3-5mm	25	24	25		40
	59		58	58	121	>5mm	11	12	11		21

NAME: Py
TOOTH #: 11
GROUP: Open

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					25	<3mm	9	8	9		18
MESIAL					26	3-5mm	5	5	5		7
	14		14	14	25	>5mm					
					24	<3mm	5	5	5		15
DISTAL					23	3-5mm	7	7	7		8
	12		11	12	24	>5mm					
					12	<3mm	3	3	3		11
BUCCAL					12	3-5mm	1	1	1		1
	4		4	4	12	>5mm					
					21	<3mm	7	7	7		9
LINGUAL					21	3-5mm	4	4	4		6
	17		17	17	21	>5mm	6	6	6		6
						<3mm	24	23	24		53
TOTAL						3-5mm	17	17	17		22
	47		46	47	82	>5mm	6	6	6		6

A-16

NAME: Py
TOOTH #: 13
GROUP: Open

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					10	<3mm	2		3	2	8
MESIAL					8	3-5mm					
	3		2	2	8	>5mm					
					14	<3mm	8		8	8	14
DISTAL					14	3-5mm					
	8		8	8	14	>5mm					
					9	<3mm	5		4	5	9
BUCCAL					9	3-5mm					
	5		6	4	9	>5mm					
					6	<3mm	4		4	4	6
LINGUAL					6	3-5mm					
	4		4	4	6	>5mm					
						<3mm	19		19	19	37
TOTAL						3-5mm					
	20		20	18	37	>5mm					

NAME: Ho
TOOTH #: 10
GROUP: Open

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					27	<3mm	0		0	0	15
MESIAL					27	3-5mm	1		1	1	10
	2		2	2	27	>5mm	1		1	1	2
					28	<3mm	5		5	5	18
DISTAL					28	3-5mm	0		0	0	8
	6		6	6	28	>5mm	1		1	1	2
					11	<3mm	0		0	0	9
BUCCAL					11	3-5mm	1		1	1	2
	1		1	1	11	>5mm					
					20	<3mm	1		1	1	9
LINGUAL					20	3-5mm	0		0	0	6
	3		3	3	20	>5mm	2		2	2	5
						<3mm	6				51
TOTAL						3-5mm	2				26
	12		12	12	86	>5mm	4				9

A-17

NAME: Ho
TOOTH #: 9
GROUP: Open

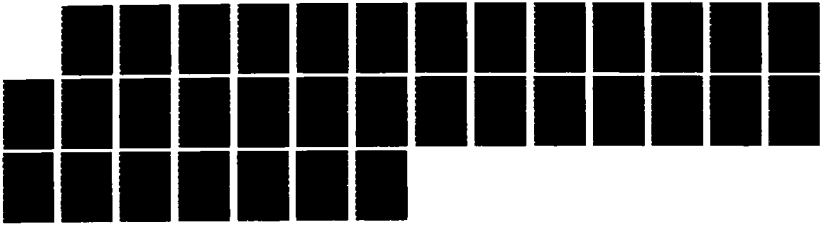
SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					25	<3mm	1		1	1	15
MESIAL					25	3-5mm	3		3	3	8
	6		6	6	25	>5mm	2		2	2	2
					26	<3mm	0		0	0	15
DISTAL					26	3-5mm	3		3	3	8
	5		5	5	26	>5mm	3		3	3	3
					8	<3mm	2		2	2	8
BUCCAL					8	3-5mm					
	2		2	2	8	>5mm					
					18	<3mm	2		2	2	9
LINGUAL					18	3-5mm	0		0	0	6
	4		4	4	18	>5mm	2		2	2	3
						<3mm	5				39
TOTAL						3-5mm	6				22
	17		17	17	77	>5mm	7				8

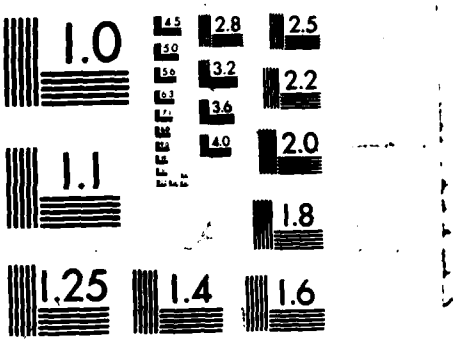
NAME: Jo
TOOTH #: 10
GROUP: Open

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					11	<3mm	4		4	4	11
MESIAL					11	3-5mm					
	4		4	4	11	>5mm					
					9	<3mm	3		3	3	9
DISTAL					10	3-5mm					
	2		4	3	9	>5mm					
					9	<3mm	2		2	2	9
BUCCAL					9	3-5mm					
	2		1	2	9	>5mm					
					8	<3mm	4		4	4	9
LINGUAL					9	3-5mm					
	4		4	4	9	>5mm					
						<3mm	13				38
TOTAL						3-5mm					
	12		13	13	38	>5mm					

AD-A172 158 THE CLINICAL EFFECTIVENESS OF SUBGINGIVAL SCALING AND ROOT PLANNING IN VI (U) AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OH L A HUMBERT 03 OCT 85 2/2

UNCLASSIFIED AFIT/CI/NR-86-168T F/G 6/5 NL





A-18

NAME: Va
TOOTH #: 12
GROUP: Open

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					31	<3mm	2	2	2	2	18
MESIAL					30	3-5mm	5	5	5	5	8
	8		7	8	31	>5mm	1	2	2	2	4
					28	<3mm	2	2	2	2	18
DISTAL					27	3-5mm	2	2	2	2	8
	5		5	5	28	>5mm	1	2	1	2	2
					8	<3mm	3	4	3	3	8
BUCCAL					8	3-5mm					
	3		4	3	8	>5mm					
					13	<3mm	3	3	3	3	6
LINGUAL					13	3-5mm	1	0	0	0	4
	5		5	5	13	>5mm	1	1	1	1	3
						<3mm	10	11	10	10	50
TOTAL						3-5mm	8	7	7	7	20
	21		21	21	80	>5mm	3	5	4	4	9

NAME: Va
TOOTH #: 13
GROUP: Open

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					16	<3mm	4	4	4	4	16
MESIAL					16	3-5mm					
	4		4	4	16	>5mm					
					23	<3mm	1	1	1	1	18
DISTAL					22	3-5mm	1	1	1	1	5
	2		2	2	23	>5mm					
					10	<3mm	2	1	2	2	8
BUCCAL					9	3-5mm	1	0	1	1	2
	3		2	3	10	>5mm					
					6	<3mm	0	0	0	0	6
LINGUAL					13	3-5mm					
	0		0	0	6	>5mm					
						<3mm	7	6	7	7	48
TOTAL						3-5mm	2	1	2	2	7
	9		8	9	55	>5mm					

A-19

NAME: G1
TOOTH #: 9
GROUP: Open

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					12	<3mm	1	1	1		12
MESIAL					12	3-5mm					
	1	1	1		12	>5mm					
					12	<3mm	0	0	0		12
DISTAL					12	3-5mm					
	0	0	0		12	>5mm					
					12	<3mm	0	0	0		12
BUCCAL					12	3-5mm					
	0	0	0		12	>5mm					
					9	<3mm	1	1	1		9
LINGUAL					9	3-5mm					
	1	1	1		9	>5mm					
						<3mm	2	2	2		45
TOTAL						3-5mm					
	2	2	2		45	>5mm					

NAME: G1
TOOTH #: 10
GROUP: Open

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					4	<3mm	0	0	0		4
MESIAL					4	3-5mm					
	0	0	0		4	>5mm					
					13	<3mm	1	1	1		13
DISTAL					13	3-5mm					
	1	1	1		13	>5mm					
					9	<3mm	0	0	0		9
BUCCAL					9	3-5mm					
	0	0	0		9	>5mm					
					6	<3mm	0	0	0		6
LINGUAL					6	3-5mm					
	0	0	0		6	>5mm					
						<3mm	1	1	1		32
TOTAL						3-5mm					
	1	1	1		32	>5mm					

A-20

NAME: M. Sm
TOOTH #: 12
GROUP: Open

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					30	<3mm	6	7	6		19
MESIAL					31	3-5mm	7	7	7		9
	15		15	15	30	>5mm	2	2	2		2
					30	<3mm	6	7	6		21
DISTAL					30	3-5mm	8	7	8		9
	16		16	16	30	>5mm					
					6	<3mm	0	0	0		6
BUCCAL					6	3-5mm					
	0		0	0	6	>5mm					
					10	<3mm	0	0	0		6
LINGUAL					10	3-5mm	2	2	2		4
	2		2	2	10	>5mm					
						<3mm	12	14	12		52
TOTAL						3-5mm	17	16	17		22
	33		33	33	76	>5mm	2	2	2		2

NAME: M. Sm
TOOTH #: 11
GROUP: Open

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					10	<3mm	5	4	4		10
MESIAL					10	3-5mm					
	4		4	4	10	>5mm					
					18	<3mm	2	2	2		15
DISTAL					18	3-5mm	1	2	1		3
	3		3	3	18	>5mm					
					5	<3mm	0	0	0		5
BUCCAL					5	3-5mm					
	0		0	0	5	>5mm					
					6	<3mm	0	0	0		6
LINGUAL					6	3-5mm					
	0		0	0	6	>5mm					
						<3mm	7	6	6		36
TOTAL						3-5mm	1	1	1		3
	7		7	7	39	>5mm					

A-21

NAME: Co
TOOTH #: 23
GROUP: Control

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					18	<3mm	17	17	17	17	
MESIAL					16	3-5mm					
	18	16	17		17	>5mm					
					15	<3mm	15	15	15	15	
DISTAL					15	3-5mm					
	15	15	15		15	>5mm					
					9	<3mm	7	7	7	9	
BUCCAL					8	3-5mm					
	7	6	7		8	>5mm					
					10	<3mm	10	10	9	10	
LINGUAL					11	3-5mm	1	1	2	1	
	9	11	10		10	>5mm					
						<3mm	49	49	48	51	
TOTAL						3-5mm	1	1	2	1	
	49	48	49		51	>5mm					

NAME: Sc
TOOTH #: 6
GROUP: Control

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					33	<3mm	21				21
MESIAL					32	3-5mm	6				7
	30	31	31		33	>5mm	3				5
					39	<3mm	20				20
DISTAL					39	3-5mm	10				10
	39	39	39		40	>5mm	9				9
					28	<3mm	12				12
BUCCAL					28	3-5mm	10				10
	28	28	28		28	>5mm	6				6
					21	<3mm	9				9
LINGUAL					21	3-5mm	6				6
	20	21	20		21	>5mm	6				6
						<3mm	62				62
TOTAL						3-5mm	32				33
	117	119	118		121	>5mm	24				26

A-22

NAME: Sc
TOOTH #: 7
GROUP: Control

SURFACE	Sq. with PC 1	2	3	# Sq	SURFACE	Sq. with PC 1	2	3	# Sq
				19	<3mm	16	16	16	16
MESIAL				19	3-5mm	3	3	3	3
	19	19	19	19	>5mm				
				10	<3mm	10	10	10	10
DISTAL				10	3-5mm				
	10	9	10	10	>5mm				
				3	<3mm	3	3	3	3
BUCCAL				3	3-5mm				
	3	3	3	3	>5mm				
				15	<3mm	6	6	6	6
LINGUAL				15	3-5mm	4	4	4	4
	14	15	14	15	>5mm	5	5	5	5
					<3mm	21	20	21	43
TOTAL					3-5mm	7	6	7	10
	46	46	46	47	>5mm	5	5	5	5

NAME: Sc
TOOTH #: 8
GROUP: Control

SURFACE	Sq. with PC 1	2	3	# Sq	SURFACE	Sq. with PC 1	2	3	# Sq
				26	<3mm	15	15	15	15
MESIAL				26	3-5mm	9	9	9	9
	26	26	26	26	>5mm	2	2	2	2
				38	<3mm	18	18	18	18
DISTAL				38	3-5mm	11	11	11	12
	37	36	37	38	>5mm	6	6	6	8
				8	<3mm	7	7	7	8
BUCCAL				8	3-5mm				
	7	8	7	8	>5mm				
				29	<3mm	12	12	12	12
LINGUAL				28	3-5mm	8	8	8	8
	29	28	29	29	>5mm	9	9	9	9
					<3mm	52	52	52	53
TOTAL					3-5mm	28	28	28	29
	99	98	99	101	>5mm	17	17	17	19

A-23

NAME: Sc
TOOTH #: 9
GROUP: Control

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					40	<3mm	18	18	18	18	
MESIAL					40	3-5mm	10	10	10	10	
	40		39	40	40	>5mm	11	11	11	12	
					28	<3mm	20	20	20	20	
DISTAL					29	3-5mm	7	7	7	7	
	28		28	29	29	>5mm	1	2	1		
					15	<3mm	12	11	11		
BUCCAL					15	3-5mm	3	3	3	3	
	14		15	14	15	>5mm					
					23	<3mm	9	9	9	9	
LINGUAL					23	3-5mm	6	6	6	6	
	23		22	23	23	>5mm	8	8	9		
						<3mm	59	59	59	59	
TOTAL						3-5mm	26	26	26	26	
	105		104	106	107	>5mm	20	20	20	21	

NAME: Sc
TOOTH #: 10
GROUP: Control

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					20	<3mm	16	16	16	18	
MESIAL					21	3-5mm	2	2	2	2	
	18		19	20	20	>5mm					
					11	<3mm	9	9	9		
DISTAL					10	3-5mm					
	9		8	9	10	>5mm					
					20	<3mm	12	12	12	12	
BUCCAL					20	3-5mm	6	6	6	6	
	20		20	20	20	>5mm	2	2	2	2	
					21	<3mm	9	9	9	9	
LINGUAL					21	3-5mm	6	6	6	6	
	21		21	21	21	>5mm	6	6	6	6	
						<3mm	46	46	46	49	
TOTAL						3-5mm	14	14	14	14	
	68		68	70	71	>5mm	8	8	8	8	

A-24

NAME: Sc
TOOTH #: 11
GROUP: Control

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					51	<3mm	19	20	19	21	
MESIAL					52	3-5mm	14	14	14	14	
	48		50	49	351	>5mm	16	16	16	16	
					56	<3mm	24	24	24	24	
DISTAL					55	3-5mm	16	16	16	16	
	56		55	55	55	>5mm	15	15	15	15	
					26	<3mm	12	12	12	12	
BUCCAL					26	3-5mm	8	8	8	8	
	26		26	26	26	>5mm	6	6	6	6	
					21	<3mm	9	9	9	9	
LINGUAL					21	3-5mm	6	6	6	6	
	21		21	20	21	>5mm	6	6	6	6	
						<3mm	64	64	64	66	
TOTAL						3-5mm	44	44	44	44	
	151		152	151	153	>5mm	43	43	43	43	

NAME: Sc
TOOTH #: 12
GROUP: Control

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					37	<3mm	21	21	21	21	
MESIAL					38	3-5mm	14	14	14	14	
	37		38	38	38	>5mm	3	3	3	3	
					38	<3mm	24	24	24	24	
DISTAL					38	3-5mm	13	13	13	13	
	38		38	38	38	>5mm	1	1	1	1	
					8	<3mm	7	7	7	8	
BUCCAL					8	3-5mm					
	8		7	7	8	>5mm					
					9	<3mm	8	8	8	9	
LINGUAL					9	3-5mm					
	8		7	8	9	>5mm					
						<3mm	60	60	60	62	
TOTAL						3-5mm	27	27	27	27	
	91		90	91	93	>5mm	4	4	4	4	

A-25

NAME: Ho
TOOTH #: 5
GROUP: Control

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					9	<3mm	9	9	9	9	
MESIAL					9	3-5mm					
	9		9	9	9	>5mm					
					9	<3mm	9	9	9	9	
DISTAL					9	3-5mm					
	9		9	9	9	>5mm					
					7	<3mm	7	7	7	7	
BUCCAL					7	3-5mm					
	7		7	7	7	>5mm					
					6	<3mm	6	6	6	6	
LINGUAL					6	3-5mm					
	6		6	6	6	>5mm					
						<3mm	31	31	31	31	
TOTAL						3-5mm					
	31		31	31	31	>5mm					

NAME: Ho
TOOTH #: 6
GROUP: Control

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					15	<3mm	15	15	15	15	
MESIAL					15	3-5mm					
	15		15	15	15	>5mm					
					7	<3mm	7	7	7	7	
DISTAL					7	3-5mm					
	7		7	7	7	>5mm					
					10	<3mm	10	10	10	10	
BUCCAL					10	3-5mm					
	10		10	10	10	>5mm					
					7	<3mm	7	7	7	7	
LINGUAL					7	3-5mm					
	7		7	7	7	>5mm					
						<3mm	39	39	39	39	
TOTAL						3-5mm					
	39		39	39	39	>5mm					

A-26

NAME: Ho
TOOTH #: 11
GROUP: Control

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					31	<3mm	20	20	20	20	
MESIAL					31	3-5mm	9	9	9	9	
	31		31	31	31	>5mm	2	2	2	2	
					24	<3mm	21	21	21	21	
DISTAL					24	3-5mm	3	3	3	3	
	24		24	24	24	>5mm					
					8	<3mm	8	8	8	8	
BUCCAL					8	3-5mm					
	8		8	8	8	>5mm					
					15	<3mm	9	9	9	9	
LINGUAL					15	3-5mm	6	6	6	6	
	15		15	15	15	>5mm					
						<3mm	58	58	58	58	
TOTAL						3-5mm	18	18	18	18	
	78		78	78	78	>5mm	2	2	2	2	

NAME: Ho
TOOTH #: 12
GROUP: Control

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					34	<3mm	24	24	24	24	
MESIAL					35	3-5mm	9	9	9	9	
	34		35	35	35	>5mm	2	2	2	2	
					38	<3mm	21	21	21	21	
DISTAL					39	3-5mm	13	13	13	13	
	38		39	39	39	>5mm	4	4	4	4	
					15	<3mm	9	9	9	9	
BUCCAL					15	3-5mm	6	6	6	6	
	15		15	15	15	>5mm					
					21	<3mm	9	9	9	9	
LINGUAL					21	3-5mm	6	6	6	6	
	21		21	21	21	>5mm	6	6	6	6	
						<3mm	63	63	63	63	
TOTAL						3-5mm	34	34	34	34	
	108		110	110	110	>5mm	12	12	12	12	

A-27

NAME: Ho
TOOTH #: 13
GROUP: Control

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					14	<3mm	14	14	14	14	
MESIAL					14	3-5mm					
	14	14	14	14		>5mm					
					14	<3mm	14	14	14	14	
DISTAL					14	3-5mm					
	14	14	14	14		>5mm					
					6	<3mm	6	6	6	6	
BUCCAL					6	3-5mm					
	6	6	6	6		>5mm					
					6	<3mm	6	6	6	6	
LINGUAL					6	3-5mm					
	6	6	6	6		>5mm					
						<3mm	40	40	40	40	
TOTAL						3-5mm					
	40	40	40	40		>5mm					

NAME: Ho
TOOTH #: 23
GROUP: Control

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					23	<3mm	17	17	17	19	
MESIAL					23	3-5mm	4	4	4	4	
	21	21	21	23		>5mm					
					26	<3mm	16	16	16	18	
DISTAL					27	3-5mm	7	7	7	7	
	24	25	24	26		>5mm	1	1	1	1	
					6	<3mm	6	6	6	6	
BUCCAL					6	3-5mm					
	5	6	5	6		>5mm					
					15	<3mm	9	9	9	9	
LINGUAL					15	3-5mm	6	6	6	6	
	15	15	15	15		>5mm					
						<3mm	48	48	48	52	
TOTAL						3-5mm	17	17	17	17	
	65	67	65	70		>5mm	1	1	1	1	

A-28

NAME: Ho
TOOTH #: 24
GROUP: Control

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					19	<3mm	16		16	16	17
MESIAL					19	3-5mm	2		2	2	2
	18		18	18	19	>5mm					
					16	<3mm	15		15	15	16
DISTAL					15	3-5mm					
	15		14	15	16	>5mm					
					6	<3mm	6		6	6	6
BUCCAL					6	3-5mm					
	6		6	6	6	>5mm					
					8	<3mm	6		6	6	6
LINGUAL					8	3-5mm	2		2	2	2
	8		8	8	8	>5mm					
						<3mm	43		43	43	45
TOTAL						3-5mm	4		4	4	4
	47		46	47	49	>5mm					

NAME: Ho
TOOTH #: 25
GROUP: Control

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					20	<3mm	15		15	15	15
MESIAL					20	3-5mm	5		5	5	5
	20		20	20	20	>5mm					
					22	<3mm	15		15	15	15
DISTAL					22	3-5mm	7		7	7	7
	22		22	22	22	>5mm					
					6	<3mm	5		5	5	6
BUCCAL					6	3-5mm					
	5		5	5	6	>5mm					
					10	<3mm	6		6	6	6
LINGUAL					10	3-5mm	4		4	4	4
	10		10	10	10	>5mm					
						<3mm	41		41	41	42
TOTAL						3-5mm	16		16	16	16
	57		57	57	58	>5mm					

A-29

NAME: Ho
TOOTH #: 26
GROUP: Control

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					31	<3mm	17	18	18	18	
MESIAL					29	3-5mm					
	30	29	29		30	>5mm					
					8	<3mm	8	8	8	8	
DISTAL					8	3-5mm					
	8	8	8		8	>5mm					
					6	<3mm	6	6	6	6	
BUCCAL					6	3-5mm					
	6	6	6		6	>5mm					
					10	<3mm	6	6	6	6	
LINGUAL					10	3-5mm	4	4	4	4	
	10	10	10		10	>5mm					
						<3mm	37	37	37	37	
TOTAL						3-5mm	4	4	4	4	
	54	53	53		54	>5mm					

NAME: Co
TOOTH #: 24
GROUP: Control

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					17	<3mm	15	15	15	15	
MESIAL					17	3-5mm	2	2	2	2	
	17	16	17		17	>5mm	14	14	14	14	
					18	<3mm	4	4	4	4	
DISTAL					18	3-5mm					
	18	18	18		18	>5mm					
					9	<3mm	8	8	8	8	
BUCCAL					9	3-5mm					
	7	8	8		9	>5mm					
					8	<3mm	6	6	6	6	
LINGUAL					8	3-5mm	2	2	2	2	
	8	8	8		8	>5mm					
						<3mm	33	33	33	34	
TOTAL						3-5mm	4	4	4	4	
	50	50	51		52	>5mm	14	14	14	14	

A-30

NAME: Mu
TOOTH #: 12
GROUP: Control

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					39	<3mm	21	21	21	21	
MESIAL					38	3-5mm	13	13	13	13	
	39		38	39	39	>5mm	5	5	5	5	
					39	<3mm	21	21	21	21	
DISTAL					39	3-5mm	12	12	12	12	
	39		39	39	39	>5mm	6	6	6	6	
					12	<3mm	9	9	9	9	
BUCCAL					13	3-5mm	3	3	3	3	
	12		13	12	12	>5mm					
					22	<3mm	9	9	9	9	
LINGUAL					21	3-5mm	6	6	6	6	
	22		21	22	22	>5mm	7	7	7	7	
						<3mm	60	60	60	60	
TOTAL						3-5mm	34	34	34	34	
	112		111	112	112	>5mm	18	18	18	18	

NAME: Mu
TOOTH #: 13
GROUP: Control

SURFACE	Sq. with PC	1	2	3	# Sq	SURFACE	Sq. with PC	1	2	3	# Sq
					41	<3mm	24	24	24	24	
MESIAL					41	3-5mm	13	13	13	13	
	41		41	42	42	>5mm	4	4	4	4	
					41	<3mm	23	23	23	23	
DISTAL					41	3-5mm	12	12	12	12	
	41		41	41	41	>5mm	6	6	6	6	
					8	<3mm	8	8	8	8	
BUCCAL					8	3-5mm					
	7		8	7	8	>5mm					
					18	<3mm	12	12	12	12	
LINGUAL					18	3-5mm	6	6	6	6	
	18		17	18	18	>5mm					
						<3mm	67	67	67	67	
TOTAL						3-5mm	31	31	31	31	
	107		107	108	108	>5mm	10	10	10	10	

B-1

1. Gingival Inflammation: Gingival inflammation was assessed using the gingival index (GI) of Loe and Silness (1963) utilizing a scale of 0 to 3. Each of four gingival areas of each tooth (mesial, distal, facial, lingual) were scored 0-3 using the following criteria:

0 = Normal gingiva

1 = Mild inflammation - slight change in color, slight edema. No bleeding on probing.

2 = Moderate inflammation - redness, edema and glazing. Bleeding on probing.

3 = Severe inflammation - marked redness and edema. Ulceration. Tendency to spontaneous bleeding.

The scores were totaled and divided by number of surfaces scored to provide a GI for the patient.

B-2

2. Plaque: The amount of plaque accumulation was assessed according to the plaque index (PlI) of Silness and Loe (1964) utilizing a scale of 0 to 3. Each of four areas of each tooth (mesial, distal, facial, lingual) were scored 0-3 using the following criteria:

0 = No plaque in the gingival area.

1 = A film of plaque adhering to the free gingival margin and adjacent area of the tooth. The plaque may only be recognized by running a probe across the tooth surface.

2 = Moderate accumulation of soft deposits within the gingival pocket, on the gingival margin and/or adjacent tooth surface, which can be seen by the naked eye.

3 = Abundance of soft matter within the gingival pocket and/or on the gingival margin and adjacent tooth surface.

The scores were totaled and divided by the number of surfaces scored to provide a PlI for the patient.

B-3

3. Periodontal Disease Index: A system for measuring separate health of gingiva, depth of crevice or pocket, plaque and calculus. Gingival and pocket score may be combined into composite score for the periodontium. Six selected teeth were examined and scored 0-3 using the following criteria for gingival status:

0 = Absence of signs of inflammation.

1 = Mild to moderate inflammatory gingival changes not extending around the tooth.

2 = Mild to moderately severe gingivitis extending around the tooth.

3 = Severe gingivitis characterized by marked redness, swelling, tendency to bleed and ulceration.

Maxillary right first molar, left central incisor, left first cuspid, mandibular left first molar, right central incisor and right first bicuspid were used. It has been shown that the mean score for these six teeth correlates well with the mean score for all teeth. Crevice depth is scored using the Michigan No. 0 probe and measuring first from the free gingival margin to the C-E junction and then from the free gingival margin to the bottom of the pocket.

The difference between the two measurements gives the

score in mm for crevice depth (i.e., from C-E junction to base of pocket).

Crevice measurements are carried out on buccal surfaces at the midpoint and on the mesiobuccal, keeping the probe pointed in the direction of the long axis of the tooth.

Gingivitis may be reported separately or combined with crevice measurement for the PDI score, as follows: When crevice measurements do not extend apical to the C-E junction, the gingivitis score will be the PDI score for that tooth. If either crevice measurement extends beyond C-E junction but not more than 3 mm, a PDI score of 4 is given. Teeth with pocket measurements of 3 to 6 mm are assigned a PDI score of 5 and a PDI score of 6 is assigned when pocket depth exceeds 6 mm. The gingival score is disregarded when the crevice measurement assigns a PDI score of 4 or more.

C-1

CLOSED

PATIENT NAME	TOOTH #	TOOTH GI	TOOTH PI	SUBJECT PDI	TIME	STROKES
Gl	# 7	1.75	1.5	5	4:05*	110*
Co	# 7	1.5	2.0	5	3:48	160
Sh	#10	1.75	0.5	5	4:18	160
Co	# 6	2.0	1.5	5	4:05	167
Co	# 8	1.5	1.5	5	4:17	178
Va	#10	1.25	1.25	5	5:01	21
Sh	#24	2.0	1.25	5	3:46	185
Jo	# 7	1.5	2.5	4	4:45	167
Jo	# 8	2.0	2.0	4	4:35	143
Ho	# 8	1.5	1.25	5	3:50	234
Sh	#23	1.0	1.0	5	3:54	165
Sh	# 9	1.75	0.5	5	4:11	175
Py	# 7	1.0	1.0	5	3:06	123
Py	# 8	3.0	1.25	5	4:10	236
Py	# 4	1.25	1.0	5	3:20	176
Py	# 6	1.25	1.0	5	2:37	127
Py	# 5	1.75	1.25	5	3:22	154
Ho	# 7	2.0	1.5	5	3:20	207
Va	# 9	1.25	1.0	5	5:20	220
Gl	# 8	1.25	1.5	5	3:49*	120*

*Dr. Waldrop

C-2

OPEN

PATIENT NAME	TOOTH #	TOOTH GI	TOOTH PI	SUBJECT PDI	TIME	STROKES
Va	#12	1.5	1.25	5	5:30	240
Gl	#10	1.25	1.25	5	2:06*	65*
Gl	# 9	1.0	1.0	5	4:18*	75*
Ho	# 9	1.75	1.5	5	3:36	175
Sh	#25	2.0	.75	5	3:21	165
Jo	#10	1.75	1.75	4	6:33	187
Ho	#10	2.0	1.25	5	3:19	189
Sh	# 8	1.5	0.5	5	7:25	175
Sh	#26	1.75	.75	5	3:25	155
Sh	# 7	1.5	0.5	5	3:44	185
Py	#11	1.0	1.0	5	4:02	176
So	#26	2.0	2.25	5	3:46	150
Py	#12	1.5	1.0	5	3:32	176
So	#24	2.25	2.5	5	4:00	153
Py	#13	1.25	1.0	5	3:10	154
So	#23	2.0	2.0	5	3:55	155
Sm	#11	1.25	1.0	6	6:30	246
So	#25	1.75	2.0	5	4:47	173
Va	#13	2.0	1.25	5	4:38	187
Sm	#12	1.0	1.0	6	6:30	246

*Dr Waldrop

C-3

CONTROLS

PATIENT NAME	TOOTH #	TOOTH GI	TOOTH PI	SUBJECT PDI	TIME	STROKES
Co	#24	1.5	2.25	5.0		
Mu	#13	1.5	2.0	5.0		
Co	#23	1.5	2.0	5.0		
Mu	#12	1.25	1.5	5.0		
Sc	# 6	1.0	1.5	5.0		
Sc	# 8	1.25	1.25	5.0		
Ho	#26	1.5	1.25	5.5		
Ho	#13	1.0	1.0	5.5		
Ho	# 6	1.0	1.0	5.5		
Ho	#12	2.0	1.5	5.5		
Ho	# 5	1.0	1.0	5.5		
Ho	#11	1.25	1.25	5.5		
Ho	#23	2.0	1.25	5.5		
Sc	#10	1.25	1.5	5.0		
Sc	# 9	1.25	1.25	5.0		
Ho	#25	2.0	1.75	5.5		
Sc	# 7	1.5	2.0	5.0		
Ho	#24	2.0	1.5	5.5		
Sc	#11	2.0	1.25	5.0		
Sc	#12	2.0	1.25	5.0		

D-1

CLOSED

PATIENT NAME	TOOTH	% P/C	% VERTICAL DISTANCE
Sh	#10	30.8%	<3-29.7%/3-5-100%
Sh	# 9	48.3%	<3-36.7%/3-5-56.7%/>5-100%
Sh	#23	20.6%	<3-20.6%
Sh	#24	51.3%	<3-51.3%
Py	# 8	68.9%	<3-53.2%/3-5-94.4%/>5-100%
Py	# 7	34.9%	<3-30%/3-5-100%
Py	# 6	45.5%	<3-46.9%/3-5-33.3%
Py	# 5	44.2%	<3-44.2%
Co	# 7	52.2%	<3-37.8%/3-5-56.7%/>5-58.9%
Co	# 6	67.1%	<3-60.7%/3-5-73.9%/>5-100%
Co	# 8	47.8%	<3-49%/3-5-52.9%
Ho	# 8	75.8%	<3-70.2%/3-5-87.5%/>5-100%
Jo	# 7	48.4%	<3-50%
Jo	# 8	33.3%	<3-33.3%
Ho	# 7	63.2%	<3-43.8%/3-5-92.3%/>5-100%
Py	# 4	54.5%	<3-63.6%/3-5-75%
Va	#10	19.5%	<3-21.2%/3-5-0%
Va	# 9	32.8%	<3-20.9%/3-5-36.8%/>5-66%
Gl	# 7*	53.6%	<3-48.8%/3-5-70%/>5-100%
Gl	# 8*	24.6%	<3-27.5%/3-5-45.5%/>5-100%

*Dr Waldrop

D-2

OPEN

PATIENT NAME	TOOTH	% P/C	% VERTICAL DISTANCE
Sh	#26	5.9%	<3-10%
Sh	#25	18.8%	<3-18.8%
Sh	# 8	48.8%	<3-26.7%/3-5-68%/>5-83.3%
Sh	# 7	29.4%	<3-29.4%
So	#25	17.2%	<3-17.2%
So	#23	23.1%	<3-23.1%
So	#26	18.9%	<3-18.9%
So	#24	2.9%	<3-2.9%
Py	#12	47.9%	<3-38.3%/3-5-62.5%/>5-52.9%
Py	#11	57.3%	<3-45.3%/3-5-77.3%/>5-100%
Py	#13	51.4%	<3-51.4%
Ho	#10	14.0%	<3-22.8%/3-5-7.7%/>5-44.4%
Ho	# 9	22.1%	<3-12.8%/3-5-27.3%/>5-87.5%
Jo	#10	34.2%	<3-34.2%
Va	#12	26.3%	<3-20%/3-5-35%/>5-44.4%
Va	#13	16.4%	<3-14.6%/3-5-28.6%
Gl	# 9*	4.4%	<3-4.4%
Gl	#10*	3.1%	<3-3.1%
Sm	#12	43.4%	<3-23.1%/3-5-77.3%/>5-100%
Sm	#11	17.9%	<3-16.7%/3-5-33.3%

*Dr Waldrop

D-3

CONTROL

PATIENT NAME	TOOTH	% P/C	% VERTICAL DISTANCE
Co	#23	26.1%	<3-96.1%/3-5-100%
Sc	# 6	97.5%	<3-100%/3-5-97%/>5-92.3%
Sc	# 7	97.9%	<3-100%/3-5-100%/>5-100%
Sc	# 8	98.0%	<3-98%/3-5-96.6%/>5-89.5%
Sc	# 9	98.1%	<3-100%/3-5-100%/>5-95.2%
Sc	#10	97.2%	<3-93.9%/3-5-100%/>5-100%
Sc	#11	98.7%	<3-97%/3-5-100%/>5-100%
Sc	#12	97.9%	<3-96.8%/3-5-100%/>5-100%
Ho	# 5	100 %	<3-100%
Ho	# 6	100 %	<3-100%
Ho	#11	100 %	<3-100%/3-5-100%/>5-100%
Ho	#12	100 %	<3-100%/3-5-100%/>5-100%
Ho	#13	100 %	<3-100%
Ho	#23	94.3%	<3-92.3%/3-5-100%/>5-100%
Ho	#24	96.0%	<3-95.6%/3-5-100%
Ho	#25	98.3%	<3-97.6%/3-5-100%
Ho	#26	100 %	<3-100%/3-5-100%
Co	#24	98.1%	<3-97.1%/3-5-100%/>5-100%
Mu	#12	100 %	<3-100%/3-5-100%/>5-100%
Mu	#13	100 %	<3-100%/3-5-100%/>5-100%

E-1

CONSENT FORM

1. I hereby volunteer to participate as a test subject in this experimental study. The purpose of this study is to examine different methods of periodontal root treatment of teeth scheduled for removal. Information gained from this study will aid in the treatment of periodontal (gum) disease.

2. I understand that I now have teeth scheduled for removal. I am aware that these teeth will be removed, with my consent, whether or not I participate in this study. Also, whether or not I participate in this study, I will undergo routine periodontal (gum) treatment on all of the teeth that will be removed. Then, if I choose to participate in this study, my teeth scheduled for removal will be divided into two groups. For one group of teeth, diseased tissue, plaque, and calculus surrounding the roots will be removed in accordance with routine pre-prosthetic procedures (with the assistance of hand instruments). For the other group of teeth scheduled for removal, the gum treatment will consist of:

a. An injection of local anesthetic to deaden the gums.

b. An incision in my gums to expose the diseased root surfaces.

c. The removal of diseased tissue, plaque, and calculus surrounding the roots.

d. A small indentation will be made on the tooth to mark the height of the gingival (gum) margin.

e. The tooth will be removed and the gum tissue will be placed back over the extraction site and be sutured back together.

3. As a participant in the study, I will need to return one week after the procedure to have the sutures removed and the area checked.

4. Risks: I understand that some discomfort can be expected when the anesthesia is administered. Although the extraction should be painless as a result of the anesthetic, it has been explained to me that I can expect to experience some discomfort when the anesthetic wears off. I also understand appropriate medication(s) will be prescribed to help decrease the discomfort.

5. I understand that I may receive no direct benefit by participating in this study. If I choose not to participate, I understand that I will continue to be managed and treated in accordance with standard medical and dental therapy.

6. I understand that my entitlement to medical care and/or compensation in the event of injury are governed by federal laws and regulations, and if I desire further information I may contact _____.

7. Records of my participation in this study may only be disclosed in accordance with federal law, including the Federal Privacy Act, 5 USC 552a, and its implementing regulations.

8. The decision to participate in this program is completely voluntary on my part. No one has coerced or intimidated me into participating in this program. I am participating because I want to. Dr. _____ has adequately answered any and all questions I have about this study, my participation, and the procedures involved. I understand that Dr. _____ will be available to answer any questions I have about procedures throughout this study. I further understand that I may withdraw this consent at any time and discontinue further participation in this study. I also understand that the investigator of this study may terminate my participation in this study at any time if he believes this to be in my best interest.

*
_____ _____
(VOLUNTEER'S SIGNATURE AND SSAN) (DATE)
(*If patient is a minor and in the opinion of the attending dentist the minor can understand his/her participation in the study, the minor should sign this line.)

_____
(VOLUNTEER'S ADDRESS)

_____ _____
(PARENT'S OR GUARDIAN'S SIGNATURE AND SSAN) (DATE)

_____ _____
(ADVISING DENTIST'S SIGNATURE AND SSAN) (DATE)

_____ _____
(WITNESS) (DATE)
(Must witness all signatures above)

Privacy Act of 1974 applies. DD Form 2005 filed in Clinical/Medical Records.

Title: The Clinical Effectiveness of Subgingival Scaling and Root Planing in Vivo; Direct Versus Indirect Root Surface Debridement.

LITERATURE CITED

1. Goldman, H. M. and Cohen, D. W. Treatment planning. Periodontal Therapy, 6th Ed., The C. V. Mosby Co.

2. Garrett, J. S. Root planing: A perspective. J Periodontol 48:553, 1977.

3. Ramfjord, S. P., Knowles, J. W. et al. Longitudinal study of periodontal therapy. J Periodontol 44:66, 1973.

4. Loe, H., Theilade, E. and Jensen, S. B. Experimental gingivitis in man. J Periodontol 36:177, 1965.

5. Allen, D. and Kerr, D. Tissue response in the guinea pig to sterile and non-sterile calculus. J Periodontol 36:121, 1965.

6. Canis, M. F., Kramer, G. M. and Pameijer, C. M. Calculus attachment. Review of the literature and new findings. J Periodontol 50:406, 1979.

7. Zander, H. A. The attachment of calculus to root surfaces. J Periodontol 4:16, 1953.

8. Moskow, B. S. Calculus attachment in cemental separation. J Periodontol 40:125, 1969.

9. Selvig, K. A. Attachment of plaque and calculus to tooth surfaces. J Periodontol Res 5:8, 1970.

10. King, J. D. The experimental investigation of periodontal disease in the ferret and in man with special reference to calculus formation. Dent Pract 4:157, 1954.

11. Hellden, L. B., Listgarten, M. A., and Lindhe, J. The effect of tetracycline and/or scaling on periodontal disease. J of Clin Periodontol 6:222-230, 1979.

12. Tagge, D. L., O'Leary, T. J., and El-Kafrawy, A. H. The clinical and histological response of periodontal pockets to root planing and oral hygiene. J Periodontol 46(9):527, 1975.

13. Waerhaug, J. Healing of the dento-epithelial junction following subgingival plaque control. I. J Periodontol 49:1, 1978.

14. Waerhaug, J. Healing of the dento-epithelial junction following subgingival plaque control. II. J Periodontol 49:119, 1978.

15. Bodecker, C. F. The difficulty of completely removing subgingival calculus. J Am Dent Assoc 30:703, 1943.

16. Jones, S. J., Lozdan, J. and Boyde, A. Tooth surfaces treated in situ with periodontal instruments. Br Dent J 132:57, 1972.

17. Nishimine, D. and O'Leary, J. T. Hand instrumentation versus ultrasonic in removal of endotoxins from root surfaces. J Periodontol 50(7):345, 1979.

18. Schaffer, E. M. Histological results of root curettage of human teeth. J Periodontol 27:296, 1956.

19. Barnes, J. E. and Schaffer, E. M. Subgingival root planing: A comparison using files, holes and curettes. J Periodontol 31:300, 1960.

20. Frumker, S. C. and Gardner, W. M. The relation of the topography of the root surface to the removal of calculus. J Periodontol 27:292, 1956.

21. Thornton, S. and Garnick, J. Comparison of ultrasonic to hand instruments in the removal of subgingival plaque. J Periodontol 53(1):35, 1982.

22. Jones, W. A. and O'Leary, T. J. The effectiveness of in vivo root planing in removing bacterial endotoxin from the roots of periodontally involved teeth. J Periodontol 49:337, 1978.

23. Stambaugh, R. V., Dragoo, M., Smith, D. M., Carrsali, L. The limits of subgingival scaling. Int J Perio Res Dent 1(5):30-41, 1981.

24. Eaton, K. A., Kieser, J. B. and Davies, R. M. The removal of root surface deposits. J Clin Periodontol 12:141, 1985.

25. Tabita, P. V., Bissada, N. F., and Maybury, J. E. Effectiveness of supragingival plaque control on the development of subgingival inflammation in patients with moderate pocket depth. J Periodontol 52(2):88, 1981.

26. Garrett, J. S. Effects of non-surgical periodontal therapy on periodontitis in humans. A review. J Clin Periodontol 10:515, 1983.

27. Cercek, J. F., Kiger, R. G., Garrett, J. and Egelberg, J. Relative effects of plaque control and instrumentation on the clinical parameters of human periodontal disease. J Clin Periodontol 10:46, 1983.

28. Caton, J., Proye, M., and Polson, A. Maintenance of healed periodontal pockets after a single episode of root planing. J Periodontol 53(7):420-4, July, 1982.

29. Badersten, A., Nilveus, R. and Egelberg, J. Effect of non-surgical periodontal therapy. I. Moderately advanced periodontitis. J Clin Periodontol 8:57, 1981.

30. Badersten, A., Nilveus, R. and Egelberg, J. Effect of non-surgical periodontal therapy. II. Severely advanced periodontitis. J Clin Periodontol 11:63, 1984.

31. Badersten, A., Nilveus, R. and Egelberg, J. Effect of non-surgical periodontal therapy. III. Single versus repeated instrumentation. J Clin Periodontol 11:114, 1984.

32. Hill, R. W., Ramfjord, S. P., Morrison, E. C., Appelberry, E. A., Caffesse, R. G., Kerry, G. J. and Nissle, R. R. Four types of periodontal treatment compared over two years. J Periodontol 52:655, 1981.

33. Pihlstrom, B. L., Ortiz-Campos, C. and McHugh, R. B. A randomized four-year study of periodontal therapy. J Periodontol 52:227, 1981.

34. Pihlstrom, B. L., Oliphant, T. H. and McHugh, R. B. Molar and non-molar teeth compared over 6 1/2 years following two methods of periodontal therapy. J Periodontol 55: 499, 1984.

35. Lindhe, J., Westfelt, E., Nyman, S., Socansky, S. S., Heijl, L. and Bratthall, G. Healing following surgical/non-surgical treatment of periodontal disease. A clinical study. J Clin Periodontol 9:115, 1982.

36. Listgarten, M. A. and Hellden, L. Relative distribution of bacteria at clinicaly healthy and periodontally diseased sites in humans. J Clin Periodontol 5:115, 1978.

37. Lindhe, J., Liljenberg, B. and Listgarten, M. Some microbiological and histopathological features of periodontal disease in man. J Periodontol 51:264, 1980.

38. Armitage, G. C., Dickinson, W. R., Jenderseck, R. S., Levine, S. M. and Chambers, D. W. Relationship between the percentage of subgingival spirochetes and the severity of periodontal disease. J Periodontol 53:550, 1982.

39. Slots, J., Mashimo, P., Levine, M. J. and Genco, R. J. Periodontal therapy in humans. I. Microbiological and clinical effects of a single course of periodontal scaling and root planing and of adjunctive tetracycline therapy. J Periodontol 50:495, 1979.

40. Mousques, T., Listgarten, M. A. and Phillips, R. W. Effect of scaling and root planing on the composition of the human subgingival microbial flora. J Periodontol Res 15(2):144-51, March, 1980.

41. Magnusson, I., Lindhe, J., Yoneyama, T. and Liljenberg, B. Recolonization of a subgingival microbiota following scaling in deep pockets. J Clin Periodontol 11(3):193, 207, March, 1984.

42. Ramfjord, S. P. Root planing and curettage. Int Dent J 30:93, 1980.

43. Rabbani, G. M., Ash, M. M., and Caffesse, R. G. The effectiveness of subgingival scaling and root planing in calculus removal. J Periodontol 52(3):119, 1981.

44. Pihlstrom, B. L., McHugh, R. B., Oliphant, T. H. and Ortiz-Campos, C. Comparison of surgical and non-surgical treatment of periodontal disease. A review of current studies and additional results after 6 1/2 years. J Clin Periodontol 10:524, 1983.

45. Lindhe, J., Westfelt, E., Nyman, S., Socransky, S. S., Haffajee, A. D. Long-term effect of surgical/non-surgical treatment of periodontal disease. J Clin Periodontol 11(7):448-58, August, 1984.

46. Ramfjord, S. P. The periodontal disease index (P.D.I.) J Periodontol 38:602, 1967.

47. Waerhaug, J. A method for evaluation of periodontal problems on extracted teeth. J Clin Periodontol 2: 160-168, 1975.

48. Loe, H. and Silness, J. Periodontal Disease in pregnancy. I. Prevalance and severity. Acta Odont Scand 21:533, 1963.

49. Silness, J. and Loe, H. Periodontal disease in pregnancy. II. Correction between oral hygiene and periodontal condition. Acta Odont Scand 22:212, 1964.

50. Sweeny, P. L., Caffesse, R. G., Smith, B. A., Morrison, E. C. and Burgett, F. G. I.A.D.R. Abstracts, 63:205, 1984.

51. Lang, N. D. Indications and rationale for non-surgical periodontal therapy. Int. Dent. J. 33:127-136, 1983.

VITA

Lewis Arthur Humbert was born on February 16, 1949, in Council Bluffs, Iowa. Graduating from Carson-Macedonia High School, Carson, Iowa, in May 1967, he attended Drake University, Des Moines, Iowa for four years receiving a Bachelor of Arts degree in May, 1971. He entered the University of Iowa Dental School in August, 1971 and received a Doctor of Dental Surgery degree in May, 1975. Following graduation, he entered the Air Force and was stationed for two and one-half years at Kelly Air Force Base, San Antonio, Texas as a general dentist. During this time, he audited the six-weeks Periodontal Course at Wilford Hall USAF Medical Center, Lackland Air Force Base, Texas, and was in charge of the Periodontics section at Kelly Air Force Base until 1977. In November, 1977, he was assigned a remote tour for one year in Osan, Korea. While there, he was appointed as Assistant Base Dental Surgeon from April, 1978 to November, 1978. After his overseas assignment, he was stationed at Luke Air Force Base, Arizona, for three years where his duties included general dentistry, health education committee and preventive dentistry officer. In July, 1982, he began a three year Air Force sponsored Residency at Wilford Hall USAF Medical Center with first year studies commencing at the University of Texas Health Science Center at San Antonio. He was admitted to candidacy for the Master of Science

degree at UTHSC-SA Graduate School in April, 1984. He was married to JoLene Watkins on September 5, 1981. They have two daughters. Jennifer Elyse was born on July 18, 1982 and Lisa Renee' on May 31, 1984. His father is deceased and his mother currently resides in Carson, Iowa.

END

10-86

DTIC